THE

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PROFESSORS *v.* ELECTRIC RAILWAYS.

THERE is not much to be said by way of congratulation to those scientific gentlemen who have helped in every way to choke and check the Clapham Junction and Paddington railway scheme. Their labours call for very little appreciation outside their family circles, and they seem generally regarded as obstructionists to a most favourable enterprise. They stood in an unenviable position, it must be confessed; for on the one hand they saw the desirability of the project from a public point of view, while, on the uncommercial side, they found themselves under the immediate obligation of surrendering their pet experiments. Their institutions being of a semi-technical character, the electric railway, as a plaything, was dear to their hearts. Had they not lectured about it, nourished it, and made toy engines? But there are mists in the mental horizon which conceal what is less pleasing in distant objects, and the electric railway, though its perspective as a thing to be was very charming, grows rough and harsh when approached so nearly.

It will be a deplorable condition for engineers if they are to be assailed on every side by any casual professor who cares to dangle straws on fibres, uttering, meanwhile, the decree that no new works will be sanctioned which shall cause either a horizontal or vertical flutter of the flimsy spider line to an extent greater than the ten-thousandth part of the ultimate limit of linear measurement. Why should engineers be trapped by these makers of cobwebs? There is not much to fear, however; the engineer is a big fly, and the professor is only an amateur spider.

It cannot seriously be thought that the simple, vague, and unqualified statements of the scientific witnesses will long prevent the building of the railway. It is surprising that the actual importance of their magnetic observations was not called more into question by the promoters.

Mr. Saunders, in his address to the committee, stated that the whole existence of the Royal College of Science and the City and Guilds Institute, for all useful purposes, depended upon the mode in which this matter was settled. Are we, then, to suppose that the whole useful work done at these colleges hangs thus upon a thread, and is a mere matter of "spot-watching?" On the contrary, we are certain that it is not, and the conclusion forced upon us is, that the statement of Mr. Saunders was erroneous. Magnetic measurements are important, but they are not sufficiently so to stop public progress; and if the professors are not clever enough to screen their instruments from the magnetic disturbances, they must find some Salisbury Plain or Yorkshire moor where special electrical and magnetic work can be done. It must be admitted that in this particular instance the railway promoters have chosen an exceptionally evil route, and we hope that by a suitable deviation they will give the professors a wider berth. A few months' delay will be time well disposed of, if the laboratories can

be freed from the greater part of the magnetic influence of the line.

Prof. Ayrton's "disturbance of about 37 deflections," and his very pretty curves, need a little elucidation before they can be understood by the mere electrician. It is a pity that these valuable data, which have served so well their purpose, should be sacrificed for want of definiteness. Parliamentary committees have a preternatural aptness which enables them to grasp, without the aid of dimensional factors, the various relations of physical quantities. With them it is only a matter of size, so that if the vertical ordinates had been drawn to twice their present scale, they would have appreciated the disturbance twice as well.

There have been many suggestions as to the real cause of all this professorial fuss, but we think an industrial contemporary goes a little beyond the actualities when speaking of the interference with research work as its primary source. Technical education must have regard to the future as well as to the present, and progress demands that research work in science should take its place with practical routine. Its remark, too, that "astronomy is now little more than an amusement," requires an infinite qualification to be true.

THE COMPOSITION OF VOWEL SOUNDS.

More than 200 years ago the inquiry into the formation of vowel sounds was the subject of scientific research; and in 1779, according to Tyndall, this was made a prize question by the Academy of St. Petersburg, and Kratzenstein was the successful competitor who gained it. In his lines Kempelen, Willis, Wheatstone, and Helmholtz have laboured, but without the prizes. Science cherishes not her children; she leaves them to make their own toys.

The invention of the phonograph was almost immediately followed by experiments on vowel tones by Messrs. Jenkin and Ewing. They employed the instrument for this purpose in 1878. The latest experiments come to us from America, in a contribution to the physical laboratory of the Massachusetts Institute of Technology, by Messrs. Charles R. Cross and George V. Wendell, in conjunction with Dr. C. J. Blake. The method is to speak a vowel into the mouthpiece of a phonograph with the cylinder revolving at a certain rate, and then to reproduce the tone with a varying rate of revolution, either faster or slower than that used when the record was impressed upon the cylinder. The experimenters then presume that any particular resonance note, if present in the tone, would have its pitch raised or lowered and the vowel sound correspondingly altered. The cylinder is driven by an electro-motor, controlled by a delicate speed-governor.

The result to be expected from such experiments would be a variation of *pitch* of every vowel, rather than a change in *timbre*, but the experimenters seem to agree that a definite *quality* of sound corresponds to each rate of rotation of the cylinder. It is not a little difficult to understand why this change of quality should be so marked as to produce a different vowel entirely at the different speeds, for the sound produced would, presumably, have the same order of harmonics with the same proportional difference in the periodic times as there is in the speeds, giving the same vowel at a higher pitch. Of course we can imagine that at higher rates some of the harmonics may pass beyond the limits of acoustic vision and so the quality might vary, but we should also be inclined to examine the phonograph itself for a mechanical explanation.

Some more definitions of vowels are wanted before the full value of these experiments can be appreciated. The writers have taken the a, e, i, o, u of the grammar books, together with some others that do not seem quite intelligible. It is now generally acknowledged that *i* and *u* are not vowels, they are clearly diphthongs, and for future experiments we would strongly advise some phonetic system. Phonetic spelling reformers probably know more about the analysis and synthesis of spoken sounds than physicists do, and we suggest Mr. Isaac Pitman's definitions of the vowels as being the most perfect for future experiments.

THE WIZARD'S PANTHEON, AND OTHER STORIES.

When Tennyson wrote about "The Fairy Tales of Science," his mind must have been influenced by some of the quaint incidental anecdotes thrust among modern scientific papers and journals by American electricians, to "medicate" them, as it were. Within the past few weeks we have received quite enough literature of this order to form an illustrated toy book; there is too much of it to run as a consecutive story, and it becomes obligatory to compound it in an abbreviated extract.

As an example we may refer to a recent paper read before an electric light convention. It commenced with a scene in the Garden of Eden, after Milton, with the contemplation of our esteemed progenitors. In this Lowther Arcadian scene we expected at last to hear the true legend of Lilith, that sweet attendant whom Adam loved before Eve was; but to our sorrow this preliminary story ends abruptly in a feeble joke, and Lilith's history is yet a mystery. What followed was a dream about the morality of an American corporation who were exterminating the snakes in Ireland, it drifted into the story of Little Red Riding-Hood and the gentleman who bought her a piano from a friend whose little boy was fishing with a rod and a line from Robert Burns about a wolf who ate up the roast lamb upon which an American corporation was about to debate. All these things are worked in so neatly that you scarcely notice it at the time; the versatility of the gentlemen is incomprehensible.

Quite the latest thing of the kind came to us from the same latitude this week. From what we can make of it, it is the story of a wizard who lived in a pantechnicon and died of incipient heart disease, aggravated by certain stimulating drugs. While he lived he had a bad way of saying the same thing twice, especially towards the end of a sentence; this, it was generally believed, hastened his death. He had a weakness for the works of Schopenhauer and a liquid called "hasheesh," which finally killed him. Lastly came the vision terrible; he saw his first wife floating amid the wandering winds and rolling spheres of space, while yet his lot lay among the waxen cylinders of weary time. One day he fell over one of these cylinders, which really belonged to a kinetographic phonograph. . . . . "But the wise crone of a housekeeper who had left her pail at the foot of the stairs,

pointed again significantly to her head, and her fellow-servants at an autopsy swore that their master had died for his beloved science, and from overwork; well knowing all the time that death was really due to his having 'kicked the bucket' which the careless one had placed beneath the steps of the pantechnicon." They collected his remains in a plate, interred them in a waxen cylinder, and thus he joined his wife among the peers of spheres.

The Berliner Telephone Patent of 1891.

We have on a former occasion called attention to this patent, No. 463,569, for a telephone transmitter, the application for which was filed on June 4th, 1877. The subject is not unnaturally causing some little stir amongst our trans-Atlantic cousins, and the electrical organs are freely discussing it in their respective columns. The patent in question is in the possession of the American Bell Telephone Company, and by means of it that company hopes to be able to extend its monopoly for practical telephony for many years to come in the States, since it broadly covers the "contact" or microphone form of transmitter. The history of the patent and other allied events which have culminated in the present remarkable situation is briefly as follows:—Soon after Berliner's application for the patent was filed, the invention found its way into the hands of the Bell Telephone Company. By an early amendment a "carbon contact," not properly defined, apparently, in the original, was introduced as an important element. The specification was further amended some three years subsequent to the date of application, during which interval experience had indicated in what direction the art of telephony really lay. In this second amendment it appears that alterations and substitutions of a wholesale character were effected. Had there been any pecuniary object in view it is not impossible that by a similar process the prior inventions of either House or Reiss, might have been transformed into comprehensive anticipations of the successful transmitters of to-day. Meantime the point respecting the "carbon contact" was contested by Edison and the interference lasted a *very* long time, being only settled on October 21st, 1891. This fact sounds rather odd at first hearing, but the circumstance becomes a little more intelligible when it is explained that both the Edison and the Berliner patents belong to one and the same company; and it is not, perhaps, unreasonable to surmise that the company had a very real and definite object in keeping alive the miniature, but very protracted, civil war. The result of this war was the issue of Berliner's patent on November 17th, 1891. It may here be stated that the first Bell telephone patent, claiming the undulatory current, expired in America on March 7th, 1893, and on January 30th next the magneto-telephone with its metal diaphragm becomes public property. As regards transmitters it appears that both the Hunnings and the Blake are already open to the American public, except in so far as they may become controlled by the fundamental patent under dispute. The latest step that has been taken in a direction aggressive to the company's policy is a suit brought by the States Government, with Attorney-General Miller as its instrument, to annul Berliner's patent. Amongst the most significant allegations in the Government Bill are the following:—In Berliner's application the transmitter is described as depending upon a make and break contact, and no other kind is described, whereas in the patent issued the action is stated to depend upon constant contact of the electrodes. The amendments and substitutions, moreover, were made after Berliner had assigned his invention to the Bell Company, and after considerable experience in applied telephony had been gained. Another point is that between 1879 and 1881 Berliner *received* six patents for telephones operating upon the constant contact principle, and in every one of these there is the same broad feature contained in the patent of 1891, and the Bill avers that it is contrary to justice and the spirit of the patent law that the monopoly of one and the same invention should be prolonged by the grant first of a patent or patents in a practical or applied form and afterwards of a patent covering the fundamental principle of the same invention. A third point is that the Bell Company, owning various patents covering broadly the constant contact principle, was in duty bound to speed the progress of Berliner's application by every legal means, and that if delay ensued through any act, or failure to act, on its part to secure this end, such delay ought to and does invalidate it; and the Bill accuses the company of intentionally neglecting its duty in this respect for the express purpose of prolonging its monopoly. It is further contended that the amended specification was drawn with consumate art, with intent, it is believed, to deceive the examiner of the Patent Office by concealing from him that the amendment introduced into the application a new and substantial invention not found in the original application; but to this accusation Berliner has filed an affidavit in which he maintains that the matter in the amendment was invented by him prior to filing the original and formed part of his original invention. The accusations made against the company, excepting possibly the latter, appear very reasonable and forcible, and we should be surprised to hear of a judgment in favour of the defendant company in the event of the case proceeding so far. We have not, however, heard what the company has to say on the subject. We understand that many years ago the Government brought a suit to annul Bell's master patent. This suit seems to be still alive although the patent is dead; and the *Electrical World* pertinently expresses the hope that the suit to annul Berliner's patent will be pushed a little more energetically, so that it may be over before that patent dies a natural death in 1908.

The Telautograph.

Now that Prof. Elisha Gray has perfected his invention, the days of the Morse code would seem to be numbered. The life and portrait of Prof. Gray has recently been published in several American exchanges, together with an account of this remarkable apparatus. The telautograph is a device for reproducing written signs at a distance. The conception of such an instrument is by no means new, but its practical application as a commercial enterprise never seems to have been permanently established. The principle upon which the machine is constructed is very much that of the pantograph. The motions of the transmitting stylus are resolved along two directions, involving two circuits between the sending and receiving stations. Each circuit includes a pole-changer, an interrupter, a receiving magnet, and a polarised relay, arranged to direct the current through one or other of the magnets, according to its polarity. There are also two local circuits, each including the magnet of one of the pole-changers, and a circuit maker and breaker, which is also connected to and operated by the pen, to change the condition of the local circuit, and thereby to change the direction of the current over the corresponding main circuit when the movement of the pen in either direction is reversed. The receiving pen is moved in two directions crosswise of each other through the action of the magnet of the respective circuits, and in opposite directions through the respective magnets of each circuit. This reads like a very complicated mechanism, but we are assured that it all works very sweetly, and the results seem excellent. It would be interesting to know whether the telautograph will work over a long distance, and whether it has yet contracted the telephonic affliction of the "K.R." law.

Effect of Pressure on Voltaic Couples.

In a recent research Dr. Gore investigated the influence of pressure upon the E.M.F. generated by a single kind of metal and a single kind of liquid; it is evident, however, that the ordinary voltaic couples composed of pairs of metals or pairs of liquids are only compound cases of the former. In such cases the matter for consideration is not only the effect of pressure at the positive metal, but also that at the negative one. The results which Dr. Gore has obtained show that the direction of the current which occurs with zinc and other positive metals is the same as that with gold and platinum; so that the effect of pressure upon the negative metal of a voltaic couple would probably be in nearly all cases to produce a greater or less amount of counter E.M.F. which would either diminish or reverse the effect due to the positive one. The amount or balance of effect, therefore, obtained with a voltaic couple would usually be very much less than with a single kind of metal. This conclusion is confirmed by the results of Gibaud's experiments (*vide Comptes Rendus*, 1891, Vol. cxiii., p. 465), in which the amounts of E.M.F. obtained by a pressure of 100 atmospheres were very much less than those usually obtained in Dr. Gore's experiments by a difference of pressure of only about two or three atmospheres. As the pressure alone attending the height of the liquid of a voltaic cell affects the E.M.F., it necessarily follows that the energy of such a cell is affected by gravity and varies with the altitude and geographical position of the cell, which is a rather startling conclusion.

Tanning by Electricity in Italy.

Too much must not be expected at first from even well calculated attempts to apply electricity to such a manufacture as that of leather, especially since tanners themselves, however expert they may be, do not fully understand the *modus operandi* of the ordinary methods that are in use for the conversion of hides into leather. As a matter of fact, however, great things have already been achieved in this department of applied electricity. In almost every manufacturing country experiments of a more or less successful nature have been carried out with a view to quickening the process of making leather by the employment of currents of electricity, and we believe there is a great future in store for this industry. At Turin, experiments are in progress under the direction of R. Pinna, in which hides are subjected to the action of weak alternating currents while immersed in the tanning liquor. A non-soluble metallic conductor of about the same superficial area as the skins is placed in the bottom of the tan-pit and the hides are spread out and piled one upon the other on this conductor. The liquor is run in until this pile is submerged completely. The second electrode is carried on a wooden frame-work and is situated above the pile, being equal in size to the lower electrode. These electrodes are varied to suit the required current density. At present the current used is 0·04—0·10 ampère per square decimeter according as the skins are light or heavy; the voltage is 50, and the frequency of the alternations 5,000 per minute. A rheostat is used for governing the current density and the temperature is kept below 35° C. Experiments are also in progress with hides stretched vertically and kept separate from each other, whilst the other conditions are the same. It is stated that an exposure of from 100—400 hours, according to the quality of the skins, is sufficient to convert the raw material into leather. And this rapidity is just the quality which will attract tanners, using the old slow processes, and induce them to give the electrical systems a trial.

Photography in the Station.

The art of photography has already proved itself of such cosmopolitan application, that we are not surprised to hear that it is to be used for obtaining a record of the readings of the voltmeter at central electric stations. At a recent meeting of the Physical Society of Berlin, Dr. Raps had on view a registration apparatus, by means of which, combined with photography, these readings can be accurately and continuously recorded. The mode of action of this apparatus may be illustrated as follows: An incandescent lamp is arranged so that the rays of light which emanate from the glowing filament are directed in a parallel sense upon a narrow slit, before which is placed the needle of the voltmeter. Obviously, in moving across this illuminated slit, the needle obscures the light and the shadow is then recorded upon the sensitised paper, as a white image upon a dark ground (the image of the illuminated slit). By an ordinary clockwork mechanism the sensitised paper, which is rolled upon a drum, is caused to move at a regular rate, and the intervals of time are recorded upon it photographically at the same time as it receives the shadows of the moving needle.

Lightning and Thunderstorms.

The Royal Meteorological Society, whose initiation of the Lightning Rod Conference will ever be gratefully remembered, recently devoted an evening to the reception of a paper from Mr. Shelford Bidwell, on some problems connected with thunderstorms. He asserted that the origin of atmospheric electricity was quite as obscure as ever it was, in spite of the "evaporation" and "friction" theories. Having granted, however, that the electrification existed without reference to the cause of it, he pointed out that the ordinary phenomena of thunderstorms were not difficult to account for. Photography had proved of the greatest assistance in determining the actual force of the lightning flash. He stated that if Dr. Oliver Lodge's theory of the "impulsive rush" discharge be correct, lightning conductors, however well constructed, cannot be depended upon to afford absolute immunity to property upon which they are erected. It must be borne in mind, however, that authorities differ as to whether this particular form of discharge ever takes place in nature. Mr. Preece, and others of his way of thinking, consider that it is only produced in the laboratory and never in nature.

The Training of Electrical Engineers.

Electrical engineers are still a little doubtful as to the most approved system of training for those in their profession who are "coming on." It is generally agreed that a good school education is the first foundation of a successful career, and this being premised, the only real matter to be decided upon is as to the proper course of practical and theoretical studies to bestow upon the specimen after it has left the young gentlemen's seminary. With the aid of dynamo designers and others, a contemporary, is putting in progress a scheme for the better understanding of the system of electrical embriology. This is already an old problem, but it has not yet lost interest, and we shall be glad to observe upon what course they ultimately decide. Men used to pattern-shops and machine construction are not necessarily the ideal projectors of an educational régime, their notions are likely to be too crystallised, and their ideas too emphatic, narrowed by their own course of life and limited to the horizon of their own workshops. The advice of a practical man is excellent to follow, if the student is certain of procuring employment in that distinct and singular department in which his adviser has learnt to advise; unfortunately, however, the electrical engineer cannot, as a rule, pick and choose his career, he is constantly thrown upon his resources, and is likely to take the first opening, whether it be to lay a cable, to design a dynamo, or to write a sublime treatise on electrolysis. It is for this reason that theoretical men, amid all their vicissitudes, have yet a little pluck, for theory lends versatility to practice, and makes it go a very long way. Our advice to young engineers is therefore "get wisdom."

OPENING OF THE ANCONA ELECTRIC WORKS.

[FROM OUR OWN CORRESPONDENT.]

On the 15th ulto., took place the opening of the first electric works in this town, which are the property of the Augsburg Gas Company which possesses the Ancona Gas Works.

In the Via Nazionale there stands opposite the gas-works an elegant building, which is the central station for the electric light in this town.

It has in the middle of the ground-floor a spacious hall for the machinery. At the sides are two one-story buildings used as dwellings for the persons employed and for stores. At the back is a lofty chimney, and except at the front the entire structure is enclosed with a wall.

In the first part of the central hall are two non-explosive tube-boilers in a common setting. A double steam pipe renders it possible to transmit the steam to the engines from either boiler or from both jointly, or to only one engine as it may be requisite. A Giffard feeding-pump and a water reservoir keep the boilers supplied.

In the second part of the central station we view the entire machinery. Two compound tandem engines represent the available power. They are provided with a surface condenser and a ventilator worked electrically to cool the condensing water.

Before each of the two engines stands an alternating current dynamo and the corresponding exciting machine. Both are driven by the same engine by means of bands. The two alternating current dynamos, respectively quite equal, are on the Zipernowsky system with 10 poles. Their capacity is 2,000 volts and 25 ampères at 500 revolutions per minute. The exciting dynamos are of 100 volts and 30 ampères at 900 turns per minute. The leads issuing from the dynamos are disposed underground in wooden channels and arrive at the switchboard where all the apparatus for measuring, regulating, &c., the current are arranged.

On closely examining the installation we find an alternating rheostat (Blathy's system) for the automatic regulation of the pressure at the primary terminals of the transformers, as it introduces automatically a stronger or weaker resistance into the magnetic circuit. A hand-rheostat is used supplementarily in case of greater fluctuations.

There is also a phase-indicator for the parallel connection of the two primary dynamos and two Cardew voltmeters, with the respective switches, which permit of every possible combination of them on the circuits.

A keyboard switch with 20 keys, from which there pass as many wires to an equal number of resistances formed of insulated iron wire, and suspended in a small adjoining room, form the "loading rheostat," which, during the action of one machine, permits of its introduction parallel to a second dynamo, or its substitution for another dynamo.

Four bipolar mercurial switches, each pair of which serve for each primary dynamo, are used for inserting it into the lead or upon the "loading rheostat."

Ammeters indicate the current produced by each dynamo, and others show the ampères absorbed by the lead and the loading rheostats.

The two exciter dynamos have their own switches for insertion or removal from the exciting current, and a hand rheostat regulates their current, which is measured from each by its special ammeters and voltmeters.

Finally, on a lofty bracket, are placed four transformers, which reduce the pressure. The current thus converted serves for the regulating and measuring apparatus, and for lighting the central station.

The primary leads pass out from the station at a pressure of 2,000 volts. They are secured to ordinary insulators fixed on lofty pillars, and conveyed over the roofs, passing along Porta Pia and Via Ventinove Settembre to two-thirds of the Corso Vittorio Emanuele, thus traversing a distance of about 1,500 metres.

Four transformers are placed at equal distances, beginning from the middle of the Via Ventinove Settembre to the extremity of their extent in the town. They are fixed upon brackets, and shut up in strong wooden boxes. Introduced parallel to the primary lead they reduce its pressure to 105 volts, for the glow lamp circuit, and are provided with terminals from which 50-volt circuits pass out for the arc lamps.

From the transformers just named the secondary lead extends in three wires, carried over the roofs or along the walls of the houses. Insulated wires branch off from the secondary lead of each transformer, each of which, at a pressure of 50 volts, serves to feed an arc lamp.

These arc lamps, on the Ganz system, provided with the accessory switch, safety contact and additional resistance, are of 16 ampère type, and are fixed at distances of 50 to 70 metres from each other along the Via Ventinove Settembre on lofty iron pillars. In the Piazza Teatra, Piazza Garibaldi, and along the Corso Vittorio Emanuele the arc lamps are placed on the middle of wire ropes stretched across the middle of the street. In the Piazza Roma there are two lamps on cast-iron pillars. In all there are 20 arc lamps. The further transformers to feed the glow lamps in the theatre and in the premises of other consumers, will be set up in future as it may be required.

If it becomes desirable, the capacity of the present installation can be doubled in a short time, since the electrical works are built of such dimensions that they will admit of double the present mechanical arrangements.

The entire works of the installation have been entrusted by the gas company to the eminent firm of Ganz & Co., of Budapest, and have been conducted by the engineer Magieni. The driving machines have been supplied by F. Tosi & Co., of Legnano, and the structure was carried out by the firm Fratelli Mengoni, of Ancona.

FREQUENCY IN TRANSFORMERS.*

Some years ago there was a very unprofitable discussion as to the relation between the dimensions and output of a dynamo. Professors multiplied the linear dimensions of phantom dynamos by n, and found the output was various fractional powers of n times that of the original phantom before they had tampered with it. The discrepancies were numerous, but they were all due to electricians assuming different conditions. The dynamos might be compared if designed so as to give the same efficiency, or the same final temperature. The copper might be run at the same current density, or the magnets at the same induction. If the same induction were employed, the armature of the larger machine, when enlarged to scale, had too many ampère turns, and so on. Then again, the larger machine could not reasonably be expected to run at the same speed, so it had to go either with the same factor of safety or the same peripheral speed. Hence there were so many ways of comparing the machines that the results of the calculations did not agree.

We are now threatened with a similar pseudo-scientific epidemic with regard to transformers and frequencies. Mr. Steinmetz calculates that the output of a transformer varies as the three-eighth power of the frequency. Obviously, if a transformer of a given size is to be re-designed with the same weights of iron and copper for, let us say, increase of frequency, it may be designed to give an increased load at the same efficiency, or with the same percentage drop, or with the same total rise of temperature, or with the same light load efficiency, and it will have a different output in each case. Again, there is no reason why in the comparison we should adhere to the same weights of copper and iron. We might vary them, keeping the total weight or total cost the same. We thus have at once pointed out twelve different laws of the relation between the output and frequency of a transformer. If other comparisons are made, such as the same bulk with different weights of copper and iron, and if allowance is made for the

* *Industries.*

relatively smaller volume of insulation on a high-frequency transformer, we obtain still more laws. It is therefore sincerely to be hoped the unpractical electrician will not flood the technical press with calculations as to the relations of output and frequency. He has so far spared us the discussion of the output of a phantom curve of sines for a transformer whose dimensions have been multiplied by n. Such calculations are quite useless.

AN EXCEPTIONALLY GOOD RECORD.*

We are permitted this month to give our readers that which the manager will most fully appreciate, and what he is seldom able to secure—a detailed statement of the earnings and expenses of an electric line which has been in operation between two and three years. As will be noted from the average number of cars daily, it is neither a large nor one of the smaller lines. The system of accounts is carried out to a

Statement of Coal Used in 1892.

1892 by month.	No. of cars operated per day.	Coal used per month.			Coal used per day.	Coal used per car per day.	Coal used per car mile.	Total value of coal used.	Cost of coal per car mile.
		Yong Sggs. at $2.35 and $2.35 per ton.	H.C. dust at 25c. and 65c. per ton.	Total.					
January	22	710,000	...	710,000	22,903	1041·04	9·35	$800.49	·01054
February	22	707,000	...	707,000	24,379	1108·13	8·99	779.19	·00991
March	23	672,400	...	672,400	21,690	943·04	8·39	735.67	·00919
April	24	717,500	...	717,500	23,916	996·50	8·20	609.38	·00925
May	24	505,900	179,000	684,900	22,093	920·54	7·54	632.49	·00685
June	24	359,500	232,300	591,800	19,726	821·70	6·70	465.59	·00527
July	24	486,900	113,900	600,800	19,380	807·50	6·41	591.00	·00630
August	24	624,900	130,200	755,100	24,353	1014·91	7·36	724.10	·00706
September	24	513,300	181,800	695,100	23,170	965·41	6·56	596.30	·00583
October	29	723,800	222,700	946,500	30,532	1052·52	7·89	250.07	·00709
November	31	765,050	130,000	895,050	29,835	962·41	7·57	971.46	·00822
December	31	761,500	296,100	1,057,600	34,116	1100·51	8·37	1011.80	·00801
Average for 12 months	25	...	...	752,812	24,682	987·28	7·76	754.79	·00779

very satisfactory distribution, and the statement shows a road operated with great care of details, and results which are highly commendable to the manager. The percentage of expense is certainly very low, especially when it is known that the service is even better than the size of the town warrants. Of course the cost per passenger of ·0288 covers only the actual transportation, and does not include anything for interest on bonds or dividends.

Who can show a better record?

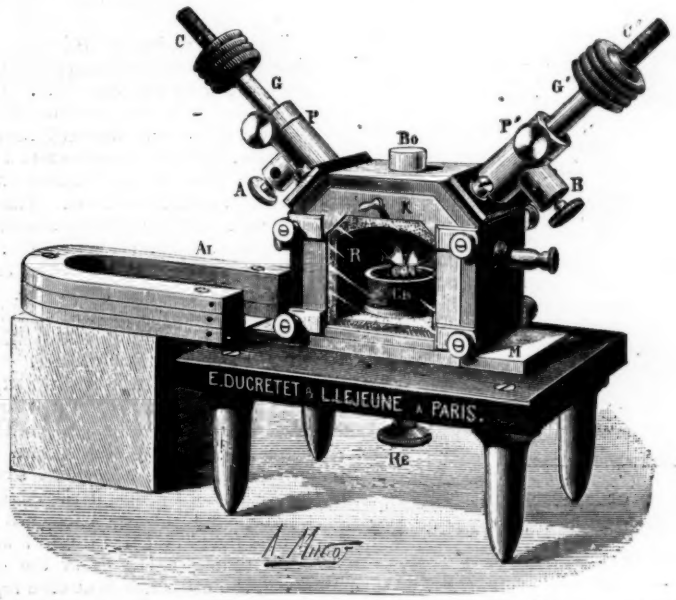
* *Chicago Street Railway Review.*

Months—1892.	Mileage.	Passengers.	Operating Expenses.												Net earnings.		Total cost of each fare.	Percentage of operating expense to gross earnings.	Cars run per day.	
			Gross earnings.		Office and Superintendence.		Motive power.		Transportation.		Maintenance of cars and motors.		Maintenance of way.		Total operating expenses.					
			Amount.	Average per car mile.	Amount.	Average per car mile.	Amount.	Average per car mile.	Amount.	Average per car mile.	Amount.	Average per car mile.	Amount.	Average per car mile.	Amount.	Average per car mile.	Amount.	Average per car mile.		No.	Average per car.
Jan....	75,923	223,141	$11,157 05	$·14695	$414 91	$·00546	$2,215 80	$·02918	$4,201 88	$·05534	$1,866 51	$·02458	$791 65	$ 01042	$9,490 75	$·12500	$1,666 30	$·02193	$·04253	85 06	22	$16 35
Feb....	78,588	221,227	11,061 35	·14074	417 27	·00530	1,968 88	·02505	4,386 32	·05581	1,987 15	·02528	941 76	·01198	9,701 38	·12344	1,359 97	·01730	·04385	87 70	22	17 33
March	80,048	242,157	12,107 85	·15125	421 79	·00526	1,584 43	·01979	4,571 70	·05711	2,091 47	·02612	1,802 00	·02251	10,471 39	·13081	1,636 46	·02044	·04324	86 48	23	16 93
April	87,413	285,389	14,269 45	·16324	406 44	·00464	1,665 80	·01905	4,631 73	·05298	1,437 08	·01644	603 45	·00690	8,744 50	·10003	5,524 95	·06320	·03064	61 28	24	19 81
May	90,811	314,751	15,737 55	·17330	264 46	·00291	1,508 02	·01660	4,849 68	·05340	1,233 75	·01357	409 33	·00450	8,264 24	·09100	7,473 31	·08229	·02825	52 51	24	21 15
June	88,306	342,276	17,113 90	·19380	269 58	·00305	1,395 59	·01580	4,810 98	·05448	1,414 18	·01601	284 91	·00322	8,175 24	·09257	8,938 66	·10122	·02388	47 77	24	23 76
July	93,687	386,097	19,304 85	·20605	214 96	·00229	1,533 20	·01636	4,912 42	·05243	1,337 16	·01427	495 54	·00528	8,493 28	·09065	10,811 57	·11540	·02199	43 99	24	25 94
Aug.	102,526	386,603	19,330 15	·18853	318 83	·00310	1,497 43	·01460	5,352 36	·05220	1,140 57	·01112	199 92	·00194	9,509 11	·08290	10,821 04	·10554	·02206	44 01	24	25 98
Sept.	101,285	372,053	18,602 65	·18366	309 34	·00305	1,508 30	·01489	5,539 26	·05468	1,250 74	·01234	268 78	·00255	8,866 42	·08753	9,736 23	·09612	·02383	47 66	24	25 83
Oct....	119,854	450,620	22,531 00	·18799	314 60	·00262	1,965 89	·01640	6,670 93	·05565	1,493 92	·01246	377 05	·00314	10,822 39	·09029	11,708 61	·09769	·02401	48 03	29	25 06
Nov.	118,130	412,773	20,638 65	·17471	330 99	·00280	2,038 78	·01726	6,532 09	·05529	2,274 18	·01925	1,403 89	·01188	12,579 93	·10649	8,058 72	·00821	·03047	60 95	31	22 19
Dec....	106,314	368,434	18,421 70	·17327	420 25	·00395	1,657 42	·01558	6,446 84	·06063	2,006 73	·01887	1,043 04	·00981	11,574 26	·10886	6,847 42	·06440	·03141	62 83	29	20 38
	1,142,865	4,005,523	$200,276 15	$·17523	$4,103 42	$·00359	$20,539 54	$·01797	$62,906 19	$·05504	$19,532 44	$·01709	$8,611 32	$·00753	$115,692 91	$·10122	$84,583 24	$·07400	$·02885	57 76	25	$21 88

THE IMPROVED DUCRETET ELECTRIC FURNACE.

The electric furnace described in our issue of March 10th has been modified and improved after many experiments by Messrs. Ducretet and Lejeune. Unlike their first 1892 type, in which the carbons were vertical, and were somewhat analogous to the Siemens furnace, the new model is provided with oblique carbons, C, C′, which are movable in their metallic mountings, P, P′.

Two sizes of the electric furnace are made, and when using the larger size the metallic carbon carriers, P, P′, must be kept cool by circulating water. The heat is intense in this apparatus, and the action of the magnet, Ai, increases it tremendously. But for a screen protecting the operator, it would be impossible to notice and follow the behaviour of the fused compounds. This screen is usually made of smoked glass or dark red ruby glass, or of superposed coloured glass sheets forming certain complementary colours, and through which the eye perceives only a neutral tint. At the same time the screen protects the face and neck against the radiated heat of the arc, otherwise the operator's epidermis would peel off, as it would in a case of sunstroke. The best protecting screen is a gelatinous bromide of silver plate, as used in photography, and which can be easily made as opaque or as transparent as desirable. The great advantage of such plate is, that it does not so easily get hot as the others.



Ducretet Electric Furnace.—A, B, terminals of the mountings, P, P′, which carry the carbons, C, C′; K, moveable door, which can be replaced by refractory substances; Cr, crucible in the shape of a cupel, made of carbon, plumbago, lime, magnesia, or of metal. This crucible is in a closed refractory case. Ai, magnet; Bo, aperture for introducing the materials which have to be smelted; M, hearth.

The crucible can be displaced at will from the outside, on its hearth, by means of a rod. Some inlets and outlets allow for the circulation of gases. The function of the magnet is to transform the arc between the two carbons, C, C′, into a long flame, and to form a real electric blowpipe. This elongated arc can be directed on the materials contained in the crucible, so that they are submitted to the highest temperature. A small crucible can bear the current of 40 ampères; but with 12 ampères and 55 volts, oxides and the most refractory ores can be reduced; metals can be fused in sufficient quantity for the purposes of chemical or spectral analysis.

This application of the magnet is based on the principle of the Jamin lamp, which was surrounded by a frame, consisting of wires traversed by the electric current, which acted on the electric light in the same way as it would act on a magnetised needle.

The remarkable researches made by M. Moissan have shown to what extent the chemists and manufacturers can utilise the electro-thermic method which will put into play, at the same time, the electric current and the chemical affinities which are easily developed by the electric arc.

According to the tests made by M. Violle, this maximum temperature is something like 3,500° C. volatilisation point of carbon. Quite recently, MM. Joly and Vezes have made at the Ecole Normale Supérieure some experiments with the Ducretet electric crucible, which allowed them to obtain in the metallic state, without oxidisation, ruthenium and osmium submitted in a closed vessel, in presence of convenient gases at the very high temperature of the electric arc.

In the open air, however rapid may be the fusion, the metal is always oxidised; to some extent the oxyhydrogen blowpipe oxidises ruthenium in melting, and therefore there is a certain loss of metal; osmium also is oxidised and volatilised in the state of osmic acid; the same occurs with all the metals which are not readily fusible, but are easily oxidisable. The solubility of amorphous carbon in iron or cast-iron in a state of fusion, as well as in other metals, is effected without difficulty by means of the arc in this electric crucible; the alloys of iron, carbon, manganese, chromium, tungsten, uranium, can be studied in this electric crucible, which besides the advantages that make it an indispensable instrument or accessory in the laboratories of chemists, physicists, and metallurgists, possesses the very appreciable one of being of a moderate price only.

VULCANISING PROCESS FOR PRESERVING AND STRENGTHENING POLES, CROSS-ARMS, TIES, &c.

An interesting paper on this subject by Mr. H. C. Myers is given in the *Electrical World* of which the following is an abstract.

Hundreds of processes for preserving wood have been patented, and all of them may be divided into two classes; 1. Those in which wood is impregnated with a preservative material by immersion. 2. Those in which a preservative agent is forced into the pores of the wood. Such chemicals as copper sulphate, zinc chloride, mercuric chloride, dead oil, &c., have been applied, but experience and results have failed to prove them all that is to be desired in an economic and effective means of wood preserving. The poisonous nature of

such chemicals makes the application and use of them very objectionable.

In the process of "vulcanising," wood is heated in closed cylinders from eight to twelve hours at a temperature ranging from 300 degrees to 500 degrees Fahrenheit, and under a pressure of from 150 to 200 pounds to the square inch. A circulation of superheated and dried compressed air removes the surface moisture and any water that does not take part in the reaction and combine with the woody constituents. Hence, wood or timber, in any condition, may be immediately treated. As the treatment penetrates to the heart of the timber, considerable time is required for cooling, which is, of course, done in the cylinder and under pressure. Timber is introduced and treated upon cars which run into the cylinder upon small tracks.

This process apparently makes decay impossible by sealing up the pores of the wood with antiseptic matter which becomes solid and firm on cooling and standing, and which is produced within the wood by the action of heat and pressure upon its original sap.

The results of tests of the prepared wood show an average increase in strength of 18·9 per cent.

The life of vulcanised timber is not known; none of the timber or ties used in railway construction during the past ten years have been known to decay. An examination was made of some 12 × 12 pine timber which had been placed in a machine shop in 1882, part being vulcanised and part untreated. The treated timber was perfectly sound and still in use, while the untreated had completely rotted and crumbled away after five years' use. It was also found that timber placed on the Manhattan Elevated Roads of New York City as far back as 1883 showed no signs of decay, and was as sound and sweet as if fresh from the tree, while untreated timber laid at the same time has rotted away and been replaced.

As vulcanising changes the sap from the liquid to the solid or semi-solid state, does not char or make the wood brittle, saturates and seals up the pores of timber with solid matter instead of liquid soluble matter which nature provides, considerable strength and durability are added by vulcanising, the wood being rendered more cohesive, harder and denser. The spike holding quality is naturally much increased, and even after ten years' service railroad spikes seem to be as firmly imbedded as when just driven.

It is also a curious fact that the electrical resistance of most woods is very greatly increased by vulcanising.

A CURIOUS ACTION OF ATTRACTION BY ALTERNATING CURRENTS.*

By ELIHU THOMSON.

A CURIOUS case of apparent attraction of closed circuits in the neighbourhood of an alternating magnetic pole, which was found in experimenting on the repulsive effects, is worth recording.

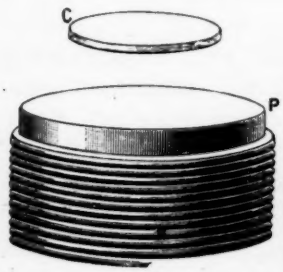


FIG. 1.

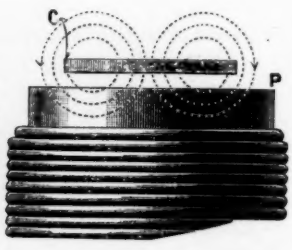


FIG. 2.

Let P, fig. 1, be an alternating magnetic pole, produced by a bundle of iron wires surrounded by a coil through which alternating currents are passed, and C a copper disc considerably smaller than the pole end P. As the disc, C, is approached to P, it will, of course, be found that it is repelled, or that a certain force has to be overcome in bringing it nearer and nearer. It will be found, however, that instead of increasing as it nears the pole, after a certain position has been passed, the repulsion diminishes, then disappears, and is at last replaced by an attractive force of considerable amount, which increases down to the position of actual contact with the pole. It is assumed that the disc, C, be kept parallel to and central with the pole face P.

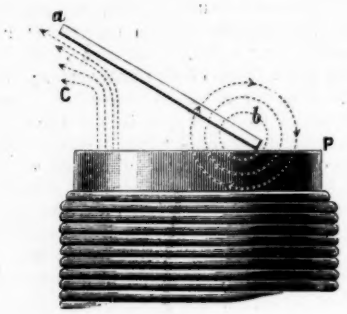


FIG. 3.

The explanation of this apparent anomaly is, I think, simple. The attraction appears to be due to the nearness of the disc, C, to the iron core. Currents are induced in C which, owing to the small diameter, relatively, do not suffer as great lag as when induced in rings or discs which encircle the pole. These currents exert an attraction for the iron of the core which at last becomes superior to the effect of the repulsion, which is feeble. The induced currents in C, in seeking a better magnetic circuit for their induction, cause the disc, C, to approach the core. The strongest attraction will, of course, exist when the current which energises the pole, P, is passing its zero value.

At this time the attraction will be understood by a glance at fig. 2, where the magnetic efforts of currents in C now have free action on the pole P.

A pretty modification of the experiment, and one in which both attraction and repulsion take part, is indicated in fig. 3. The disc may be set in the position inclined, as shown, and attraction at *b* may keep it from being thrown off the pole, while repulsion at *a* sustains something less than one-half the weight of the disc in the inclined position shown. If the alternating pole be presented in a horizontal direction, it will also be found that the disc will adhere to the pole, and slip down to a position below the centre. If it slips too far down, the attraction is at once replaced by a quick repulsion which casts the disc away from the pole quite suddenly. With the pole completely inverted or facing outward, the attraction will be sufficient, in some cases, to hold the full weight of the disc against the pole.

* The *Electrical World*.

Personal.—A complimentary dinner to Mr. J. Gavey, of the Postal Telegraph Department, on the occasion of his promotion to the position of Chief Technical Officer of the Engineer-in-Chief's Office, was given on Wednesday last at the Freemason's Tavern. Mr. Gavey for some years past has acted as superintending engineer of the South Wales District of the Post Office Telegraphs, and through recent changes, consequent on the death of Mr. E. Graves, late engineer-in-chief, was selected to fill the important position which he now occupies. The promotion has generally been felt to have been well deserved, and the idea of giving a complimentary dinner was warmly taken up. About 30 friends, who had been officially or otherwise connected with Mr. Gavey during 20 years past, were present at the dinner, which was under the chairmanship of Mr. C. A. Gerhardi, and letters of regret from numerous other friends, who were unable to attend, were read.

Mr. J. Curra has been appointed a technical officer of the Engineer-in-Chief's Office, General Post Office.

NOTE ON THE DISRUPTIVE STRENGTH OF DIELECTRICS.*

BY CHARLES PROTEUS STEINMETZ.

WHEN an insulating medium is exposed to a great electrostatic stress, quite independent of its specific electric resistance at a certain E.M.F., disruptive discharge takes place, that is, a spark—followed by the arc, where the supply of electricity is sufficiently large—passes through the dielectric, and such mechanical and other changes take place therein that its resistance is practically reduced to *nil*.

To investigate this phenomenon further, especially to determine the dependence of the sparking distance upon the E.M.F., a number of tests were undertaken.

As E.M.F. an alternating E.M.F. had to be used, since the sources of high continuous potentials, the electrostatic machines, are not capable of giving perceptible currents of electricity, and since at these high potentials a very perceptible escape of electricity into the air takes place, the required constancy of potential in the discharge circuit can be ensured only by the use of a source of electricity capable of yielding perceptible currents. Hence, the required potentials were derived by converting a low pressure alternating current by step-up transformers.

As source of the low pressure current, a small Westinghouse 50-volt and 1 H.P. alternator was used, which was driven by a 3 H.P. Eickemeyer motor† with a speed corresponding to a frequency of approximately $N = 150$ complete periods per second. The E.M.F. of the alternator was varied by varying the exciting current, up to 80 ~ 90 volts.

The potential was increased by means of a special transformer, except in the lowest readings (below 4,000 volts) of the tests made with air, where two small Westinghouse transformers (voltmeter converters) were used. Each of these transformers had two coarse-wire or 50-volt coils, and one fine-wire or 1,000-volt coil, and by suitably connecting the coils, the following ratios of transformation were derived:

$$1 \div 10,\ 1 \div 20,\ 1 \div 40.$$

The discharge plates were connected into the fine-wire circuit, the alternator into the coarse-wire circuit. The voltmeter—an electro-dynamometer‡ was connected across the coarse-wire or primary circuit, and the secondary potential calculated by means of the ratio of transformation, which was permissible in this case, since the magnetisation was always far from saturation.

For all the other tests, a special transformer was used, which is shown in fig. 1. This transformer was built up in

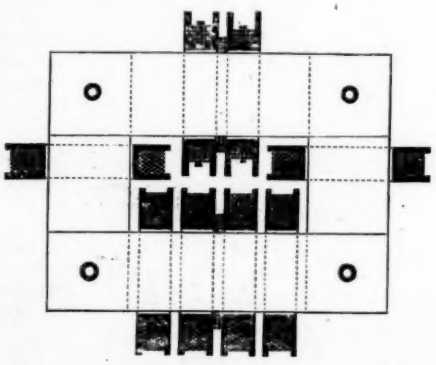


FIG. 1.

rectangular form of alternating sheet-iron plates of 12½ inches × 3 inches, and of 9½ inches × 3 inches, 3 inches high, giving a cross section of the magnetic circuit of 4½ square inches = 29 cm.², and a length of 30 inches = 76 cm. approximately. Eight spools were used, two primary spools of wire No. 10 A.W.G., one of 50 turns—the other of 20 turns. The 20 turn coil was excited by the alternator. The secondary circuit consisted of 6 spools of thoroughly paraffined wood of $\frac{3}{16}$ths inch thickness, each spool containing 1,000 turns wire No. 22 A.W.G. Usually, the secondary coils were all connected in series; for some tests, only 3 coils were used, the two halves of the secondary circuit being connected in parallel.

Since the magnetisation was occasionally pushed up to high saturation, where the exciting current became large, and the ratio of turns does not equal the ratio of transformation, and since under these circumstances magnetic leakage is no longer negligible, the voltmeter was not connected across the primary, but a special voltmeter circuit provided of 20 turns ordinary lamp cord, of which 10 turns were wound between the two primary spools, 10 turns between the middle spools of the secondary circuit, as shown in fig. 1. The voltmeter was the same electro-dynamometer as in the former tests.

With open secondaries, and 50 primary turns, the equation of this transformer is, at $N = 100$ complete periods per second,

$$V = \frac{1{,}000\ A}{40 + 5{\cdot}75\ A},$$

where V are the volts, A the amperes of the primary circuit. (effective.)

With all the six secondary coils connected in series in *short-circuit*, at $N = 100$ complete periods, the equation of the transformer is, approximately,

$$V = 1{\cdot}33\ A.$$

The E.M.F. of the high potential circuit was calculated from the voltmeter readings by the ratios,

$$1 \div 150 \text{ and } 1 \div 300.$$

Since at the frequency $N = 150$ and this arrangement of the secondary coils for the potentials used in the tests, the influence of the capacity is still negligible.

In the tests made with the Westinghouse converters—which date back to July, 1891—as discharge plates, two polished rectangular (2½ inches × 1½ inch × ½ inch) Norway iron blocks were used, with a piece of mica of measured thickness between them, which contained a hole of $\frac{1}{8}$th inch to $\frac{1}{4}$ inch diameter as spark gap.

FIG. 2.

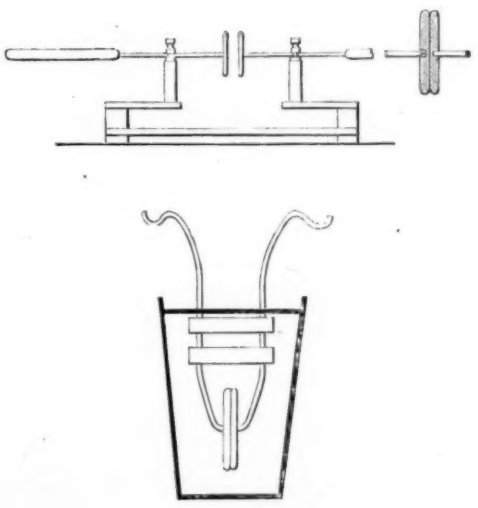


FIG. 3.

As electrodes or discharge plates for the high potentia converter, two brass discs of 2 inches diameter and $\frac{3}{16}$ths inch thickness were used, well polished and with their edges carefully rounded off. They were held by two brass rods, or wires, of $\frac{1}{16}$th inch diameter on hard rubber pillars, which were fastened on overhanging hard rubber sheets, so that by their elasticity the discharge plates were pressed against each other. The one electrode was fastened on the brass wire, the other rested on a point, to adjust itself to close parallelism. The whole was mounted on a hard rubber plate, as shown in fig. 2. For testing liquids, the arrangement shown in fig. 3 was used,

* A paper presented at the seventy-fourth meeting of the American Institute of Electrical Engineers, New York, February 21st, 1893.

† The same two machines which were used for the electro-dynamometer tests communicated in previous papers, "On the Law of Hysteresis," Vol. ix., pp. 3, 621.

‡ Of which the constants are given in the first paper "On the Law of Hysteresis," Vol. ix., p. 8.

consisting of two bent brass wires held $1\frac{1}{2}$ inch apart, but pressed together by two soft rubber cross pieces, and carrying at their lower ends the same discharge plates of 2 inches diameter.

In the test with air or liquids, the electrodes were kept apart by pieces of glass or mica of measured thickness; in the tests with solid materials, the test piece was laid between the electrodes, which pressed against it.

The tests were made in the following manner:—The test piece was brought between the discharge plates; then the primary circuit of the alternator closed while the exciting current was at its lowest value, and then simultaneously the exciting current increased slowly, and with the other hand the voltmeter needle made to follow the increasing potential, until the test piece broke down, which was noticed by the sudden drop of the voltmeter, due to the short circuit of the secondary. Then quickly the exciting current was broken, the voltmeter read, the electrodes cleansed, a new test piece adjusted, &c.

By the ratio of the turns of the voltmeter exciting coil, and of the high potential circuit, $1 \div 150$ *vs.* $1 \div 300$, from the effective voltmeter reading, the effective potential at the discharge plates was found, and by assuming the sine law of E.M.F. wave, that is, by multiplication with $\sqrt{2}$, the maximum potential at the electrodes or discharge plates calculated.

The connection between electrodes and secondary coils consisted of two short pieces of rubber insulated wire, which were carried through the air, so that practically no escape of current could take place from them.

The application of the potential always lasted but a short time—not over 15 seconds. Still, all the materials became more or less heated before breaking down.

The exactness of this method of testing is necessarily limited, and the results may possibly contain a constant error due to the deviation of the E.M.F. from sine shape—so that the maximum E.M.F. is not exactly equal $\sqrt{2} \times$ effective E.M.F.—and an error in the counting of the secondary turns, which, though done very carefully, is unavoidable with such a large number as 6,000 turns. This possible constant error, however, can amount to a very small percentage only, probably not exceeding 2 per cent.

Where several tests were made with the same thickness of material, and gave nearly the same result, the average of the readings was taken, and the number of readings marked in the table.

In the following tables, in the first column, the maximum difference of potential where the dielectric broke down, is given in kilo-volts or thousands of volts, as v.

In the second column, the thickness of the dielectric, or the sparking distance, is given in milli-centimetres or thousandths of centimetres, as $\delta_{obs.}$.

From these two observed quantities, in the third column, the electrostatic gradient $g = \frac{v}{\delta_{obs.}}$ is calculated, in kilo-volts per centimetre.

From these tests, empirical formulæ, expressing the interdependence of v and δ, were calculated, and the value of δ calculated by the means of these formulas, given in the fourth column as $\delta_{calc.}$.

The fifth and sixth columns give the difference between $\delta_{calc.}$ and $\delta_{obs.}$ in milli-centimetres and in percentages of $\delta_{calc.}$.

First I tried the equation of the hyperbola,

$$\delta = \frac{a\,v}{b - v},$$

which would give a finite value $v = b$, where δ becomes infinite, that is discharge takes place into the air. This function did not satisfy the results at all, as seen from the last column of Table I., and within the range of observation, no tendency to electrostatic saturation was noticed. It would give a limiting value of v at about 79 kilo-volts.

With some materials, the tests agreed fairly well with the linear function,

$$\delta = a\,v,$$

showing that at a definite electrostatic gradient, $g = \frac{1}{a}$, the dielectric breaks down, independent of its thickness.

TABLE I.

DISRUPTIVE DISCHARGE THROUGH AIR.

$$\delta = 36\,(e^{-1\cdot2\,v} - 1) + 54\,v + 1\cdot2\,v^2.$$

Maximum difference of potential in kilo-volts. v	Sparking distance observed, in milli-centimetres. $\delta_{obs.}$	Electro-static gradient in kilo-watts per cm. g	Sparking distance calculated in milli-centimetres. $\delta_{calc.}$	Difference, $\delta - \delta$ calc. obs. Δ	Difference in per cent. of $\delta_{calc.}$ %	Remarks. $\delta = \frac{v}{65 - 29\,v}$	
·18	3·0	60	2·2	− ·8	(−36)	3·0	
·26	4·6	57	3·8	− ·8	(−21)	4·5	2·3
·29	5·1	57	4·5	− ·6	−13·3	5·1	‖
·46	8·1	57	8·9	+ ·8	+ 9·0	8·9	v at
·48	9·1	53	9·5	+ ·4	+ 4·2	9·4	δ at
·53	11	48	11·0	0	0	10·7	
·71	16	44	17·1	+ 1·1	+ 6·4	16·0	‖
1·43	48	30	49·3	+ 1·3	+ 2·6	(62)	δ
1·76	68	26	66·4	− 1·6	− 2·4		
2·46	100	25	105·7	+ 5·7	+ 5·4	First term has disappeared.	
3·96	190	21	197	+ 7	+ 3·5	$\delta = \frac{v}{1{,}8 - 2{,}26\,v}$	
5·5	287	19	297	+10	+ 3·4	(332)	
9·5	575	17	584	+ 9	+ 1·6	605	79
12·7	860	15	844	−16	− 1·9	852	v =
15·7	1,150	14	1,110	−40	− 3·6	1,097	δ at
19·6	1,440	14	1,480	+40	+ 2·7	1,457	
22·6	1,730	13	1,800	+70	+ 3·9	1,780	‖
24·0	2,010	12	1,950	−60	− 3·1	1,935	δ
Average	...	...	...	±14·7	± 4·2	...	...

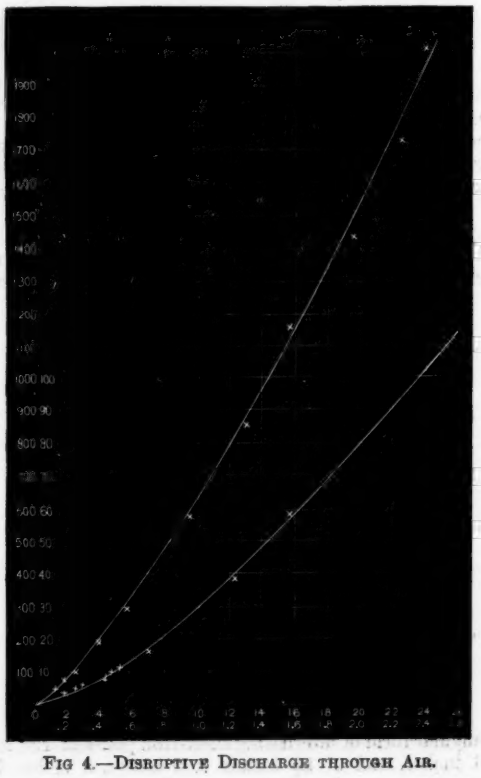


FIG 4.—DISRUPTIVE DISCHARGE THROUGH AIR.

Other materials did not follow this equation at all, but the sparking distance increased quicker than the E.M.F. The addition of a quadratic term,

$$\delta = a\,v + b\,v^2,$$

gave fair agreement with the tests.

(To be continued.)

ON LIGHTNING RODS.

We have received a pamphlet by Major Pescetto, of the Italian Royal Engineers, in which is ably summarised the present position of the protection of buildings from lightning. He tells us that from the time of Franklin's experiments almost to the last few years the fundamental principles of protection against damage by lightning have remained unaltered. Variations have merely been introduced in details, the principal of which was the progressive diminution of the zone supposed to be protected.

These principles may be thus summarised:—

1. By means of conductors raised above the zone to be protected, and terminating upwards in a point towards the sky, an electric equilibrium is maintained between the storm cloud threatening the region and the region in question, so as to prevent the action of lightning.

2. To present to the lightning by means of conductors having their lower extremity in good communication with moist earth; if, in spite of the preventive action of the points it discharges itself upon the zone, we create for it an easy way to pass to the earth without damaging what is found within the zone and thus to preserve it from damage by lightning.

The *preventive* action depends on the property of points to facilitate the re-establishment of equilibrium between two opposite electric charges, and the *preservative* efficacy depends upon the good conductivity of the conductors, assuming that an electric charge behaves like a continuous current.

Admitting these principles, the problem is easy, and a good solution demands merely good sense and good workmanship.

But it has happened often, indeed, too often, that lightning rods, established according to the types approved by the Academies, have not protected the buildings to which they were affixed, and that the lightning has left the way prepared for it, and supposed to be the easiest, and has leaped here and there, breaking, killing, and destroying. But it was not admitted that lightning could behave in this manner without some reason, and the fault was sought in the defective character of the earth.

Meanwhile studies were proceeding on the phenomena accompanying the electric charge.

The merit of having recalled attention to the necessity of studying the setting up of lightning rods from a new point of view, belongs to Prof. Lodge. In two lectures delivered in 1888, before the Society of Arts, he performed some experiments of capital importance.

The lectures of Lodge occasioned much sensation in England, where a short time previously (1882) there had been published a report (that of the Lightning Rod Conference), in which were detailed the rules to be followed in the erection of lightning rods, according to customary principles.

Hence the ideas of Lodge excited very lively discussions at the British Association (Bath meeting), and afterwards at the Institution of Electrical Engineers.

Lodge at that time published a stout volume under title "Lightning Conductors and Lightning Guards." It is a treatise on the protection of manufactories, telegraphic instruments, submarine mines, and such electric structures, against damage from electric discharges. Here he describes and discusses his experiments and those of others.

The present author, in his "Nota sull 'Impianto der Parafulmini," proceeds to the compilation of new rules which increase the probability, if it cannot always reach certainty, of obtaining effective protection against injury from electric discharges.

He then enters upon general considerations concerning atmospheric electricity and lightning. He admits that at present nothing can be affirmed with absolute certainty concerning the origin of atmospheric electricity. He considers it highly probable that it may be due to the friction of aqueous particles against the surface of rocks and of ice, and perhaps against the air itself. But whatever may be the cause of electrification, it is probably in continuous action producing a difference of potential between the upper strata of the atmosphere and the surface of the globe.

In polar regions the electric discharges are in general silent, and take the form of the aurora borealis. In our latitudes discharges in this form are very rare.

Taluno believed we could refer the high potential of the clouds to the aggregation of small electrified aqueous globules into larger masses.

An inverse fact has been discovered and demonstrated by Lord Rayleigh, that aqueous globules tend to unite under the action of small electric discharges in their vicinity.

When a flash shoots, whether from a cloud or from the earth, there is established a condition of things which favours the discharge of another flash or of several lightnings, practically simultaneous with the former and in the same line.

Lightning has an oscillatory character. Precise data are wanting as to the duration of a flash of lightning, but it seems not to exceed the hundred thousandth of a second, and since its rapidity is such, we must necessarily take account of the phenomena described. The discharge of lightning is almost certainly oscillatory, composed of a series of discharges in opposite directions, and the rapidity of alternation will be very great, above 1,000,000 per second, and therefore, for the mechanical resistance of the conductor, much greater values must be substituted.

Of the two metals generally adopted for conductors, copper and iron, the author prefers the latter, in which he agrees with Lord Kelvin and Mr. Preece, of the British Telegraph Service, who has the superintendence of not less than 500,000 lightning rods.

Sparks may be given off from gas brackets, from water-cocks, from keys laid on a table, from any metallic object, and especially from the extremities of a metallic circuit. If a gas jet is open the spark ignites it, and thus occasion may be given for a fire, as has actually happened.

It is certain that the conductors most exposed to lightning are aerial telegraph and telephone wires, but even those underground or under water are not completely secure.

In 1865 Hughes and Guillemin recognised that an absolute protection of the apparatus at telegraphic stations could not be obtained by any of the lightning rods in use. The experiments of Lodge confirm this fully.

Summary of the Controversial Points.—Lightning rods, as now constructed, are frequently effectual; but sometimes they fail, even with the best earth, as they present to the lightning a much worse way than was at first supposed. The present lightning rods may therefore produce lateral discharges, and promote discharges by induction from other conductors.

Although it is necessary for the conductor of a lightning rod to have a certain conductivity, this has a much less importance than it was until lately supposed. The impediment encountered by an oscillating discharge depends more on self-induction than on metallic resistance.

A good and deep earth is most desirable for the protection of the gas and water mains, and besides, it is necessary to keep the value of the impedance as low as possible. The only objection which is made to the existing theory is its having drawn to it (the earth) an exaggerated and almost exclusive attention.

Meantime, for the extremity of the lightning rod turned towards the sky, it was generally admitted that a few points would suffice, whilst the lower extremity was of the greatest importance. Whenever a lightning rod had not acted as it should, the scapegoat was a *bad* earth.

The experiments of Lodge and Chattock proved that the discharging action of needle points is insignificant. It is an important fact that hundreds of needle points do not suffice to discharge the electricity furnished by a small induction machine.

The zone of protection, the extent of which has been so much discussed, does not exist, since lateral discharges may set out from the very shaft of the lightning rod.

Besides the system, so to speak, classical, there is that proposed by Maxwell, founded on a fact demonstrated by Cavendish in the last century, that in the interior of a hollow conductor there is no trace of an electrostatic charge. A complete security would be presented by a cage of links, not too large, made of metal wire, so long as it was not fused. This is the Melssens system.

(To be continued.)

Birkenhead Electric Lighting.—The borough is to be lighted with electricity. The Corporation have decided to at first spend £10,000 on the work, and when the demand justifies them in extending, such extensions can be made.

THE ELECTRIC LIGHTING OF DRESDEN.

[FROM OUR OWN CORRESPONDENT.]

(*Concluded from page* 336.)

O. L. Kummer & Co. calculate the expense for gas, condensing water, cleansing materials, and lubricants, and, on the other hand for heating the boilers, removing ashes, cleansing and lubricating, respectively at 79,600 marks and 21,940 marks. On Siemens & Halske's project they calculate the corresponding sums respectively at 50,112 and 23,800 marks. The difference with the former firm amounts to 57,660 marks, and with the latter to 26,312. From this surplus of expense there may certainly be deducted saving in wages, as gas motors require less supervision and labour than steam engines and boilers. Kummer & Co. estimate the differences at 5,400 marks, but Siemens & Halske make them 8,750 marks; whereby the differences are reduced to 52,260 marks, or respectively to 17,562 marks. To this excess of cost must be added, in the projects of the group II., the cost of maintenance of the batteries of accumulators which are estimated respectively at 6,200 and 4,800 marks. Thus then appears a total difference of 58,460 marks (Kummer and Co.), or of 22,362 marks (Siemens & Halske), to the disadvantage of the projects with gas motors.

Further considerations against the erection of single generating stations within the city are the apprehension that on the scale required the noise and smell may be perceptible; and secondly, the want of unity in working and management. This evil would make itself more felt with an increased number of stations.

It has been early recognised that the alternating current is better adapted than the continuous current to supply extensive spaces with electric energy without excessive expense, on account of the readiness with which its tension and strength of current may be transformed as required. Still the technics of the alternating current have been developed relatively slowly. As reasons against the adoption of the alternating current there have been alleged :—

1. The impossibility of its direct application for electrolytic purposes.
2. The less advantageous distribution of light with alternating current arc lights than with such as are fed with the continuous current.
3. The difficulty of actuating motors with an alternating current.
4. The lower degree of safety.
5. The impossibility of storing up the alternating current.
6. The noise produced by the alternating current.
7. The danger of high tension alternating currents.

The inapplicability of the alternating current for electrolytic purposes scarcely comes into consideration for electric works, since galvano-plastic and metallurgical establishments generally produce current for their own uses.

The evil that alternating current arc lights project their light as much upwards as downwards, has been combatted by means of reflectors; but they are still less favourable than the continuous current lights. The unsteadiness of the alternating current lights has been overcome by means of more numerous alternations.

The difficulty of actuating motors with the alternating current has now been overcome.

Irregularities at electric works with the alternating current were formerly not rare. But these difficulties may now be regarded as overcome. Two of the signatories (Rittershaus and Weinhold), from their own observations at Vienna, were convinced that the certainty and trustworthiness of the alternating current system, as operated in Vienna, is by no means inferior to that of the best continuous current works. The operations required for parallel introduction were effected rapidly, and without perceptible influence on the steadiness of the light.

The possibility of storing up current in secondary batteries is important, chiefly for small electric works and private installations. For large works it is of less importance. The Berlin works, which use continuous current, and are of great extent, are entirely without storage batteries.

In alternating current apparatus of the most recent construction, the humming or buzzing noise is so much reduced, that it can no longer form a serious objection. At a machinery station on the plot of ground at Reick, the noise would, in any case, be a matter of indifference.

The danger of alternating currents at a tension of 2,000 to 2,500 volts has been formerly altogether denied by over-zealous champions of the alternating current. But since within seven weeks three fatal accidents have occurred in Austria and Germany from the use of such currents, they can be no longer denied. We may also infer, from the decidedly more intense nervous irritation produced by an alternating current of moderate tension, as compared with a continuous current of the same intensity, that a high tension alternating current must be more dangerous than a continuous current of the same intensity. But as high tension alternating current is used only in those parts of an electric installation with which the consumers of current have nothing to do, whilst the leads to which the lamps, &c., are connected, convey merely transformed current of low tension, the question is no longer whether a high tension alternating current is in itself dangerous, but whether there is a danger that such a current may pass over into the low tension leads and come in contact with the consumer. In the earlier transformer applied in practice, such a transit was possible by a rupture of the insulating materials, and may have really occurred. But transformers are now constructed with such excellent insulation that this danger no longer exists.

The undersigned believe that at present, according to their best knowledge and with due regard to all the circumstances which come into question, they must recommend the alternating current for the works to be erected in Dresden. They point out that the Allgemeine-Elektrizitäts Gesellschaft (Universal Electricity Company), who have hitherto applied the continuous current on a very large scale in the Berlin electric installation, propose for Dresden only the alternating current distribution.

The six plans of group III. differ greatly among themselves, both in cost, which in the project of Kummer & Co. is almost half a million marks higher than in that of O. V. Miller, and in the details of the system. The plans of the Allgemeine-Elektrizitäts Gesellschaft, of Helios, and of O. V. Miller, assume a directly produced current of high tension, the two former 2,000 volts and the last 2,500 volts. The plans of Kummer, II., and Siemens and Halske, II. and III., assume an alternating current produced directly at 150 volts, and brought to a high tension by primary transformers (Kummer & Co. to 3,500 volts, and Siemens and Halske to 3,000 volts).

Among the various systems only of group III., that only of Helios has been practically tried; that is to say, the system of Ganz & Co., of Budapest, whose patents, constructions and experience are fully placed at the disposal of the firm Helios.

In case the City of Dresden adheres in general to the resolve to erect electric works with an alternating current distribution, the undersigned would recommend that some firms should be invited to send in new plans on the basis of more definite conditions as to the erection of the works.

They consequently allow themselves to propose new regulations which should be adopted. Some of these are :—

1. The machinery station is to be at Reick.
2. Motors and dynamos are to be proposed for 11,000 16-candle glow lamps or their equivalent, burning simultaneously (18,000 lamps being set up), and one group of machinery being kept as a reserve.
3. The current is a single-phase alternating current of, at most, 150 volts tension, with not fewer than 100 polar changes per second, and to be raised to 2,000 volts in primary transformers.
4. The continuous current for exciting the alternating machines is to be produced in special continuous current machines separate from the former.
11. The high tension current must be converted by means of "house transformers" into a service current of the tension of 72 volts. The construction of the transformers must afford complete security against the contact of persons with parts at high tension, and against the transit of the high tension current into service lead or into gas and water-piping, &c. Short-circuiting must be rendered impossible.

If the matter is to be confined to the smallest possible number of firms, it may be recommended to select the three firms, Helios, Kummer & Co., and Siemens and Halske.

The undersigned, by reason of the experience of other

places, feel bound to recommend that the entire installation (except the buildings erected by the Local Board of Works), should be entrusted to one firm, which should alone undertake the responsibility for the entire works.

(Signed) Lewicki.
Rittershaus.
Weinhold.

Dresden, September 29th, 1892.

TELEPHONIC COMMUNICATION BETWEEN BELFAST AND GLASGOW.

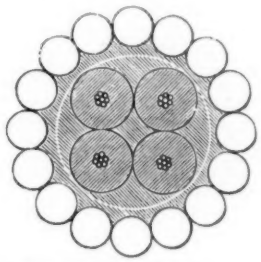
On the 4th inst. H.M. Post-Office telegraph ship *Monarch*, successfully laid a new cable between Donaghadee on the Irish coast and Port Kail on the Scotch coast, containing four conductors of special size, designed for telephonic use between Great Britain and Ireland.

Just two years ago the first London-Paris telephone circuit was opened to the public; a second has since been provided, both lines being erected jointly by the English and French Governments. But this method of intercommunication between towns in the United Kingdom has hitherto only been furnished on the Government system to a few groups of towns having local business connections in Northumberland and Durham, South Wales, and similar localities. In the last Session of Parliament, however, the House of Commons expressed its opinion by resolution that the Post-Office should provide trunk telephone lines for public use, and subsequently a large sum was voted to enable the Postmaster-General to extend the system by the erection of new wires, and by acquiring those already erected by private companies, under license from the Postmaster-General.

Steps were accordingly taken by the Post-Office to provide main arteries of communication between the largest towns; and the link between Great Britain and Ireland was one of the first put in hand. The engineering staff of the Post-Office has been busily engaged during the last eight months in erecting the land wires; and the cable connections having been completed on the 5th inst., the wires were tested by J. C. Lamb, Esq., C.M.G., the Telegraph Secretary to the Post-Office, and W. H. Preece, Esq., F.R.S., President of the Institution of Electrical Engineers, and Engineer-in-Chief to the Post-Office.

We are informed that speaking from the Belfast Post-Office to Glasgow was found to be exceedingly good. Conversation was carried on with such perfect ease and freedom that the distant speaker seemed to be quite close at hand. The line is declared, by competent judges, to be quite three or four times as good as either of the London-Paris circuits.

Amongst the first to speak between Glasgow and Belfast were Lord Kelvin, Sir John Burns (the Lord Provost of Glasgow), and Sir Daniel Dixon (Lord Mayor of Belfast), who all expressed their gratification with the great success of the new communication. The great natural obstacles to the transmission over long distances of the extremely weak and fine currents required to represent the vibrations of the voice, the resistance of the circuit, its electrostatic capacity and the extraordinary sensibility of the telephone to be affected by feeble currents induced by signals passing to and fro in neighbouring wires, have been overcome most successfully; the first by greatly enlarging the size of the conducting wires, so as to produce the least possible resistance, the second by employing the least possible length of covered wire, whether submarine or underground, and the third by using a return wire, or, as it is called, a metallic loop for one circuit, one going, the second returning, on the same poles, the result being that the disturbing induced currents caused by adjoining wires are produced in both the going and the returning wire, and they neutralise each other in the telephone. To ensure that each wire forming the loop shall preserve the same mean distance from the disturbing causes, the two wires are made to exchange their positions by revolving or twisting round each other, like the strands of a rope, over the whole distance, about seven complete twists being made in every mile, of course, without one wire touching the other. This twist is maintained throughout the whole circuit, in the underground and cable sections as well as in the overhead wires. The Belfast-Glasgow line will be opened very shortly to the public for conversation. The charge for a conversation of three minutes' duration will be 5s. The charge for a conversation of similar length, between London and Paris, is 8s. The length of the Belfast-Glasgow line is 150 miles; the London and Paris is 303 miles.



Section of the telephone cable laid between Port Kail (Scotland) and Donaghadee (Ireland) on April 4th, 1893.

The cable in the former case is 23½ nautical miles in length, while in the latter it is somewhat shorter, or 21 nautical miles. The two cables are practically identical. The conductors (four in number) are formed of high conductivity copper wires, each being 160 lbs. in weight, and having an electrical resistance at 75° F. of 7·5 ohms per nautical mile. The gutta-percha dielectric weighs 300 lbs., and the electrostatic capacity is ·3 microfarad per nautical mile. Both cables were made by Siemens Bros. & Co. They differ in one point only. Surrounding the core of the Irish-Scotch cable is a sheathing of brass tape, intended to protect the conductors from the depredations of the various species of teredo. This is the first cable laid by the British Post Office that has this protection. Our waters have, up to recent times, been free from these destructive insects, but they are now showing themselves around our coasts, and will have to be reckoned with in future.

As the Belfast-Glasgow line is intended later on to form the central section of a longer circuit, extending in one direction to Dublin and Cork, and in the other to Edinburgh, and possibly eventually to Aberdeen and Inverness, it has been built of very heavy wires. The land lines on both sides are composed of copper wires, 800 lbs., and having an electrical resistance of 1·12 ohms per statute mile. There is only one short piece of street underground work of about 1,600 yards length in Glasgow. This is formed of a dry core cable of low capacity, the conductors being copper wires of 150 lbs. to the mile. As is well known, the presence of underground wires and submarine cables on long telephone lines, adds enormously to the "electrical" length of the circuit.

By the end of the present financial year (March 31st, 1894) London will have telephonic communication on the Post Office telephone trunk wires with Brighton (to which town the circuit is already completed), Nottingham, Derby, Sheffield, Leeds, Hull, Newcastle, Manchester, Liverpool, Edinburgh, Glasgow, Dublin, Belfast (*viâ* the second pair of wires in the Port Kail-Donaghadee cable just laid), Ipswich and Colchester. Leeds will be the great provincial centre, and a cross-country line will be erected from that town to Birmingham, Bristol, Cardiff, &c., giving communication also with them. The construction of direct circuits to these last-named towns, and to Plymouth, Exeter, Southampton, Portsmouth and other places in the West and South, will be proceeded with and completed, it is anticipated, by the end of 1894.

LEGAL.

Woodhouse and Rawson United, Limited.

In the Queen's Bench Division of the High Court of Justice on Tuesday, the 11th inst., Mr. Justice Vaughan Williams (sitting as an additional judge of the Chancery Division) had before him four petitions in relation to this company.

Mr. Buckley, Q.C. and Mr. Wheeler appeared in support of the first—that of Miss Dora Longfield.

In opening the petition, Mr. Buckley said that he asked for a compulsory order, winding up the company. His client was the

holder of £250 worth of debenture stock in the company, which had made default in the payment of interest. The company was incorporated in 1889 for the purpose of amalgamating a number of other companies with whose names the name of Woodhouse and Rawson was variously connected. The companies he referred to were Woodhouse and Rawson, Limited, the Woodhouse and Rawson Electric Supply Company of Great Britain, the Woodhouse and Rawson Electric Manufacturing Company, the Woodhouse and Rawson Contract and Maintenance Company, Limited, and C. L. Baker and Company, Limited. The company had carried on business up to the present time, and had paid several dividends at the rate of 15 per cent. He (Mr. Buckley) should contend that these dividends were never earned at all. There was a guarantee of dividend given by the vendors for the three years from the date of the incorporation of the company, and it turned out that so far from their being in a position to pay a dividend of 15 per cent., the company was quite unable to pay its liabilities, or to pay interest upon its debentures and debenture stock.

Sir HORACE DAVEY, Q.C., appearing for the voluntary liquidators of the company, said he should contend that the petitioner was not a creditor of the company at all.

Mr. BUCKLEY said that if that was so, he should like to know whose creditor she was. The company first issued in 1889 40,000 ordinary shares of £5 each, 30,000 preference shares of £5 each, and £100,000 first mortgage debentures. On February 12th, 1891, the directors issued a second prospectus, under which Miss Longfield applied for debenture stock, offering 2,000 further ordinary shares of £5 each and 10,000 further preference shares of £5 each, and £100,000 5½ per cent. second debenture stock. The balance-sheets of the company were issued from time to time, and the first one (according to an affidavit) showed a nett profit amounting to £61,085, though, as he was instructed, no profit was made at all.

Mr. JUSTICE VAUGHAN WILLIAMS said they must first dispose of the point, which he understood was raised, whether Miss Longfield was a creditor entitled to present a petition.

Mr. BUCKLEY read the instruments under which his client acquired her interest in the company.

Mr. JUSTICE VAUGHAN WILLIAMS: Your contention is, that the respective stockholders can enforce their debts; you will have to admit that the respective stockholders cannot enforce the security.

Mr. BUCKLEY said that a stockholder could enforce his security in an action brought on behalf of himself and all others, but when one security was vested in trustees for the benefit of all, no one man could enforce it for the benefit of himself, though any one could enforce it for the benefit of himself and others. In the case of a debt, his contention was that there was nothing to prevent a man enforcing his security for himself alone. In this case, he submitted, there was a debt created as between the person who paid the money and the company, and therefore his client was in the relation of a creditor to the company, and entitled to petition for a winding-up order.

Sir HORACE DAVEY said that the voluntary liquidators of the company were bound to see that no order was obtained except upon the petition of a creditor who had a right to present it. The only point he desired to submit was, that Miss Longfield had not in law or equity any debt which entitled her under the Companies' Acts to present a winding-up petition. The question was: did the instrument and the contract upon which she paid her money as sealed with the company' seal and handed to her, constitute a debt between her and the company upon which she was entitled to sue either at law or in equity? His submission was, that there was nothing in the transaction, or the certificate or the draft deed which in any way created the relation of creditor as between her and the company, and that all rights of enforcing her security were vested in the trustees.

Mr. FARWELL, Q.C., appeared in support of a petition on behalf of the Rate and Tax Payers', &c., Association, and submitted that an order should be made on that, because the first petition was invalid.

Adjourned for the day.

On Wednesday morning the discussion on Miss Dora Longfield's petition was continued.

Mr. GEORGE WHITE, on behalf of another petitioner, said he was instructed to support a compulsory order for winding up. The mere fact that the petitioner was a secured creditor did not deprive him of his right as an ordinary creditor for winding up the company. There were certain circumstances in relation to the formation of this company, and the way the company had been carried on, which necessitated the making of some enquiry.

Mr. WHEELER said, in the absence of his leader, Mr. Buckley, he was willing to have a supervision order. The liquidator could not object to a supervision order being made in this petition.

Sir HORACE DAVEY suggested that the same order should be made in the other two petitions, which were presented by the Rate and Tax Payers' Association, Limited, and by John Tullis and others. It would not then be necessary to decide the somewhat difficult question of law as to the *locus standi*.

Mr. EUSTACE SMITH for the Rate and Tax Payers' Association, also thought that the same order should be made on the three petitions.

Mr. UPJOHN: My client wants a compulsory order.

Mr. JUSTICE WILLIAMS: I cannot make a compulsory order if none of the petitioners will take it—they have abandoned it. If this matter had come on a week or two later, I should have been willing to do that which I wish to do now, and that is to substitute your client as petitioner, if you wish to have an opportunity of presenting a petition.

Sir HORACE DAVEY said the liquidator was perfectly neutral, and it was his duty to give opportunity to those who desired to file affidavits.

Mr. JUSTICE WILLIAMS: There is only one creditor, now, who wishes for a compulsory order. According to my view, he ought to have an opportunity of making an application for a compulsory order if he likes. As soon as the rule which has been made comes into force, he would do this by merely asking to be substituted for the petitioner who abandons the petition for a compulsory order. But at present that rule is not in force; it will come into operation on the 29th inst. My intention is to give this man an opportunity of taking that course.

Sir HORACE DAVEY: I presume the creditor for whom Mr. Upjohn appears would have no difficulty in filing his petition at once.

Mr. UPJOHN said he appeared for Dr. Duncan, who held 100 ordinary and 200 preference shares. As he appeared for a contributory, and not a creditor, he was at present in a difficulty.

Sir HORACE DAVEY submitted that a shareholder was bound by the resolution for voluntary winding-up.

Mr. JUSTICE WILLIAMS: Generally he is; not always.

Mr. UPJOHN: The gentleman who instructs me also advises the holder of debenture stock, whose interest is in arrear—that gentleman can afterwards be substituted.

Mr. JUSTICE WILLIAMS: I propose to adjourn this matter until after the 29th, when the new rule comes into operation.

Mr. WHEELER: Then I reserve for my client the opportunity of applying for a compulsory order when the case again comes on.

Mr. JUSTICE WILLIAMS: Oh, yes. On the 29th the new rule comes in which enables me, upon the hearing of any petition, if those who present it abandon the petition, to substitute another petitioner.

The three petitions were adjourned accordingly.

THE ELECTRICAL SUPPLIES AND FITTINGS COMPANY, LIMITED.

ON Tuesday, in the Chancery Division of the High Court of Justice, the case of the Electrical Supplies and Fittings Company came before Mr. Justice Vaughan Williams, on the petition of the Electrical Company, for the winding-up of the company. The company was incorporated in 1890, with the nominal capital of £20,000, of which only £1,470 had been actually paid up. Learned counsel, who appeared in support of the petition, said the company was insolvent, and the shareholders had passed a resolution for voluntarily winding-up, but the creditors were of opinion that their interests would be prejudiced by the continuance of the liquidator appointed by the shareholders. The company, it was understood, went to allotment on a subscription amounting only to £1,720, of which they had received £1,470, and they had incurred very large debts, the liabilities amounting to between £4,000 and £5,000. After argument, his Lordship said he was not satisfied with the information that had been supplied him, and he directed the petition to stand over until the first petition day after 26th inst.

NOTES.

Portsmouth Electric Lighting.—It is proposed to fix the price to private consumers at 6d. per unit.

Llangollen Electric Lighting.—The question of electric lighting the town has been deferred for a month.

Southport Electric Lighting.—The question as to which system of distribution is to be adopted at Southport is to be submitted to an expert.

Worcester Electric Lighting.—A Local Government enquiry was held on Thursday, last week, regarding the application to the Corporation to borrow £39,109 for electric lighting purposes.

Burnley Electric Lighting.—The Electric Lighting Committee intend recommending the Town Council to charge consumers 6d. per unit. Circulars are to be sent out for the purpose of ascertaining the number of residents in Burnley Wood district likely to use the electric light.

Dundee Electric Lighting.—The Sub-Committee have been instructed to consider and report as to the electric lighting of further central streets in the city. It has been suggested that the lamps in the High Street be altered, with a view to distribute the light more equally.

Leeds Electric Lighting.—A question was asked at last week's meeting of the Council, as to what steps had been taken towards obtaining electrical power for lighting the corporate buildings from the mains of the Yorkshire House-to-House Company, in order to remove the nuisance caused by the machinery under the municipal buildings. In reply, it was stated that the said company were not yet in a position to supply the energy required. In the corporate buildings there were about 3,000 lamps and the company were not in a position to light that number in all Leeds.

Society of Arts.—On Wednesday next, 19th inst., Mr. Gisbert Kapp will read a paper on "Some Economic Points in Connection with Electricity Supply."

Hastings Electric Lighting.—At the monthly meeting of this Council, last week, it was reported that the contract with the electric light company for the lighting of the whole of the front line had been completed.

Darwen Library Electric Lighting.—The Corporation have decided that the New Free Library and Reading Room be lighted by electricity at an estimated cost of £700. Estimates have been invited from six firms for the carrying out of the work.

Glasgow Telephone Service.—At a recent meeting of the Glasgow Town Council it was remitted to a special committee to consider the question of applying to the Postmaster-General for a license to supply the community with an efficient telephone service.

Middlesbrough Electric Lighting. — The Electric Lighting Committee of the Middlesbrough Town Council, at their last meeting, appointed a Sub-Committee to obtain information as to the cost of lighting the Municipal Buildings with electricity, and also for providing an arc lamp for each corner of the buildings.

Incandescent Lamp From a Commercial Standpoint.—In our issue last week, in the article on this subject, we refer at the bottom of column 2, page 398, to Mr. Carl Hering's paper as having appeared in our issue for March 31st. The paper, however, appeared in our issue for March 24th.

Edinburgh Electric Lighting. — The Edinburgh Merchants' Association are petitioning the Town Council not to take up the electric lighting of the town themselves, but to hand it over to a public company. The same day as the above Association came to this decision, the Sub-Committee of the Town Council resolved, by 8 votes to 3, to recommend the Council to take the matter in hand themselves.

Church Electric Lighting.—There is a desire on the part of the vicar of Leeds Parish Church to have the building lighted by electricity, and a letter has been written to the *Yorkshire Daily Post* by "a layman," pleading in very passionate terms for subscriptions towards the installation of "the safest, the brightest, the purest and the best light." The expense of the necessary installation is said to be about £500.

Kingston Electric Lighting.—A Local Government Board enquiry into the application of the Kingston Town Council to borrow £16,000 for the purpose of lighting the borough by electricity was held last week. It was proposed at present to provide 5,000 private incandescent lamps and 40 arc lamps for street lighting, but it was hoped to light the whole borough by electricity shortly. There was very little opposition.

Lectures.—At the Central Higher School, Sheffield, last Monday, Mr. W. H. Watkinson, M.I.M.E., M.I.E.E., lecturer on electrical engineering at the school, commenced a series of lectures on "Electricity as Applied to Welding, Forging, Tempering, Melting and Smelting."

A lecture on "Electricity" was delivered the other day before the Caithness Literary Society by Mr. Anderson.

Before the Royal Scottish Society of Arts, last Monday, at their meeting in Glasgow, Mr. John Ritchie read the second part of his paper on the "Utilisation of Water-Power."

Obituary.—We regret to have to record the death of Mr. C. P. De Sauty, which occurred on the 11th inst., at Gibraltar. Mr. De Sauty commenced his career in the Submarine Telegraph Company, and was afterwards in the employ of the Telegraph Construction and Maintenance Company. For the last 27 years he has acted as Chief Superintendent of the Gibraltar Station of the Eastern Telegraph Company. As an electrician, Mr. De Sauty has long been known, having, especially during the earlier part of his career, contributed many practical papers on the science.

Fire.—On 31st ult., the McKeesport (Pa.) Electric Light Company's plant caught fire and was totally destroyed. The loss will be from $75,000 to $100,000.

Blackpool Electric Lighting.—At the monthly meeting of the Town Council on Tuesday there was a discussion regarding the charges to be made for the electric light. In moving the adoption of the proceedings, Councillor Pearson said the committee, although empowered to charge 8d. per unit, only proposed to charge 6d., with certain discounts for payment within certain periods.

Preston Electric Lighting.—Two large weaving sheds, now being erected at Preston by Messrs. Horrockses, Crewdson & Co., the well-known cotton spinners and manufacturers, are to be fitted with the electric light, and the same principle will be extended to a spinning mill about to be built by the same firm on adjacent land. Two of the weaving sheds belonging to the firm have been lighted for some time with the electric light, and the results have been so satisfactory, as to lead to the present extension of this system of illumination.

Afraid of the Search Light.—The last number to hand of *Indian Engineering* contains an amusing note regarding the electric search light at the bombardment of Alexandria. Mr. Wallace, C.E., in a recent lecture, recorded a protest against the addition of projectors to the appliances of warfare. The protest was made by an engineer officer to Arabi, and stated that while repairs were being conducted at a certain fort in July last the English ships threw a light on the works, which so frightened the workmen that they all ran away, and would not be persuaded to return.

An 800,000-watts Brillié Meter.—A meter of 800,000 watts, on the L. Brillié system, has just been made for the Norman Electricity Company, for their new works at Rouen. This meter is intended for a three-wire distribution of 8,000 ampères and 100 volts. We believe that this is the largest continuous current meter that has yet been made; the largest before this having been a 200,000-wattmeter, constructed by the same company for the Société des Métaux, Paris. This 800,000-wattmeter is furnished with a recording arrangement, giving at each instant the curve of the watts passing into the apparatus. This recorder is on the principle of a cinemograph, having a constant speed imparted by a small electric motor to the horizontal plate, and also to the drum on which the paper is rolled. The drum makes one revolution in 24 hours. The needle of the cinemograph is worked by the action of the electric motor. When no current is passing into the apparatus, the needle is brought to the centre of the horizontal plate, and consequently to zero; as soon as a current passes through the meter, the latter being started, the needle is displaced by a quantity corresponding to the number of watts, and traces the curve. This cinemograph is based like the meter, on the equilibrium of forces, and is consequently quite independent of the variations caused by friction, &c. The whole apparatus is very ingenious, and will render great service in the central stations. A meter of the same type, but smaller, for 50 ampères, is now in use by the Kensington and Knightsbridge Electric Light Company. We learn, moreover, that the Continental company constructing the Brillié meters has entirely remodelled the form of the present meter, at the same time preserving its principle. This new pattern (which is not yet patented), possesses, besides the advantages of the original arrangement, the great advantage of being excessively simple in its construction. The Brillié meter was objected to as being complicated; the latest pattern has the advantage of great simplicity, not being either heavy or bulky (but at the same time solid in construction), and therefore moderate in price. It is hoped soon to have in the market a new model suited to the present requirements of the Board of Trade. The constructors have sought to realise in the electricity meters the advantages of gas meters, *i.e.*, they have tried to arrive at a meter combining the advantages of cheapness, solidity of construction, simplicity of working, few parts in motion, accuracy and proportionality, reliability as to starting for low currents, and what is of equal importance, not to be influenced by the variation of friction in the parts in motion.

Patent Rights.—A correspondent says that the following paragraph is a clause in the specification drawn up for wiring the "Free Library," Manchester:—"The contractor shall indemnify the corporation against all actions for infringement of patent rights, and against all costs or loss arising therefrom, with adequate security satisfactory to the corporation, or obtain licenses as may appear to the corporation most expedient."

Electrician Imprisoned for Stealing a Bicycle.—Percy Gordon Glynn, 27, electrician, was indicted at Northampton Quarter Sessions last week for stealing a bicycle, of which he was the bailee, at Kettering, on September 22nd last. Prisoner pleaded not guilty. Mr. Disney prosecuted, prisoner was undefended. The jury returned a verdict of guilty. He was sentenced to three calendar months' hard labour.

CONTRACTS OPEN.

Aberdeen.—April 28th. The Town Council invite tenders for boilers, engines, dynamos, switchboards, &c., batteries, cable. Further information will be found in our advertisments.

Bedford—May 13th. Applications are requested by the local authority for the transfer of the Bedford electric lighting order to a company. See our advertisements for further particulars.

Manchester—April 15th. For the installation of electric lighting, including wiring and appliances at the Free Reference Library, for the Manchester Corporation.

BUSINESS NOTICES, &c.

J. A. Berly's Universal Electrical Directory for 1893 (12th year), is now ready, 784 pp. This standard work contains a larger amount of trade information than any other similiar publication, and should be in the hands of every engineer or electrician. Free within the Postal Union for 4s.

Failure of a Birmingham Electrical Engineer.—A meeting of the creditors of Arthur Henry Wright Radcliffe, electrical and telegraph engineer, residing in Claremont Road, Handsworth, and lately carrying on business in Newton Street, Birmingham, was held last week at the office of the Official Receiver. Mr. Dale appeared for the bankrupt.—The statement of affairs showed liabilities £766 13s. 6d., assets £59 7s.—The bankrupt commenced business in 1867, with a capital of £500, his principal department being the erection of railway, telegraph, and telephone lines. In 1888, through losses on contracts, and illness of himself and family, he suspended payment, and the creditors accepted a composition of 3s. in the pound. He owed at that time about £2,000, and his assets amounted to something like £400. His present insolvency was attributed to a claim by his sister-in-law for £100, to bad trade, and losses on contracts. For eighteen years bankrupt had the contract for the maintenance of the Corporation telephone wires, for which he received £140 per annum. The loss of that contract in September, 1891, was a serious drawback to him.—The case was a summary one.

Rugby School Electric Lighting.—Mr. J. A. McMullen, who is an old Rugbeian, has been appointed consulting engineer to the scheme for electric lighting Rugby School, which is to be carried out during the ensuing term and summer vacation. The scheme includes the schools, the chapel, and nine boarding houses, the gymnasium, the sanatorium, the Temple Library and Art Museum, and all other buildings connected with the School. The total number of lamps, some of 16 and some of 8 C.P., will be about 1,500. As many of the buildings are at a considerable distance from the proposed site of the generating station, it is possible the alternating system will be employed. It is also probable that a Dowson gas plant will be adopted, together with a special type of gas engine, having two impulses per revolution.

Electric Lighting of the London and River Plate Bank (New Premises).—This bank has just removed from 2a, Moorgate Street to Princes Street. After carefully considering the question of obtaining their supply from the outside mains they have determined that in view of the entire success obtained during the last six years from the installation put down by Messrs. Drake & Gorham, to remove the whole apparatus for the lighting of their new premises in preference to obtaining current from the City of London Supply Company. The moving of the whole of the plant was carried out during the Easter vacation without any cessation of the light during working hours, and the running of the engine in the new premises is found to be quite inaudible in any of the surrounding offices.

The Electrical and General Engineering College and School of Science.—Under this new title Mr. de Tunzelmann is extending considerably the Penywern House Engineering School. We have received the April prospectus which sets forth the class and workshop arrangements for the next term. New workshops are being fitted up and will be ready during the course of this term. The engine and dynamo room is being enlarged, and the gas engine hitherto used is to be replaced by a Marshall & Sons' steam engine. The instructing staff is a strong one and well able to sustain the reputation of the college. We gather that students joining the college during the next few months will have opportunities of gaining practical experience in the carrying out of a lighting and power installation.

The Nottingham Electric Light and Power Company, Limited.—At an extraordinary general meeting of the Nottingham Electric Light and Power Company, Limited, held at 22, Low Pavement, Nottingham, on March 11th, 1893, the subjoined extraordinary resolution was duly passed; and at a subsequent extraordinary general meeting of the said company, held at the same place on March 29th, 1893, the same resolution was duly confirmed: "That the company be wound up voluntarily, under the provisions of the Companies' Acts; and that Walter Griffith, of Low Pavement, Nottingham, be and he is hereby appointed liquidator for the purposes of such winding up."

An Electrician's Affairs.—The first meeting of the creditors of Austin Herbert, of 20, Leonard Street, Beverley Road, Hull, Yorkshire, recently residing at Westhorpe, near Southwell, Nottinghamshire, and trading at St. James's Street, Nottingham, as an electrician, was held at the offices of the official receiver, Mr. H. R. Thorpe, St. Peter's Church Walk, Nottingham, last Monday morning. The summary of the statement of affairs shows that the liabilities to unsecured creditors amounts to £172 5s. 11d. The assets are estimated as worth £55, leaving a deficiency of £117 5s. 11d. No resolution was passed, and the affairs were left with the official receiver.

Theft of Electric Lighting Apparatus.—John H. Pollitt was charged last Saturday in the Salford Borough Court with stealing two electric bells, 18 coils of wire, three gongs, and other articles from the works of the General Electric Light Company, Clegg's Court, Chapel Street. The total value of the articles stolen was said to be about £3. Another man named Charles Woodward was charged with receiving a number of the articles knowing them to have been stolen. Pollitt was fined 40s., or 14 days' imprisonment, and Woodward was liberated on his recognisances to come up for judgment when called upon.

Departure.—Mr. H. Hirst, representing the General Electric Company, will sail to-morrow by the *Etruria* for New York, *en route* for Chicago, in the first place, to arrange for an extensive exhibit of everything electrical of his company's manufacture, and, secondly, to introduce the "H.I." system among electrical firms in the United States and Canada. We trust our genial friend will have a pleasant trip and achieve all the success he so well merits.

Great Northern Railway Company.—The Great Northern Railway Company have accepted the tender of the Brush Electrical Engineering Company for the supply and erection of the alternators and arc dynamo machines for the large station to be put down at Holloway, for lighting a number of the railway stations up and down the line.

Earl's Court Exhibition.—The Brush Electrical Engineering Company have contracted for the supply of the electric generating plant required for the electric lighting of the Gardening and Forestry Exhibition to be held at Earl's Court this year.

Correction.—In our last issue we stated that Mr. C. N. "Rupell" had joined the London and Lancashire Electric Company. This should read Mr. C. N. Russell.

Appointment.—Mr. W. H. Patchell, A.M.I.C.E., M.I.E.E., has been appointed chief engineer to the Electricity Supply Corporation, Limited.

Change of Address.—Mr. J. Swinburne, consulting engineer, has changed his address to 4, Hatherley Road, Kew Gardens.

CITY NOTES.

City of London Electric Lighting Company, Limited.

THE third ordinary general meeting of this company was held yesterday afternoon at Winchester House, Sir David L. Salomons, Bart., presiding.

The SECRETARY (Mr. J. Cecil Bull) having read the notice convening the meeting,

The CHAIRMAN said he presumed they would take the report and accounts as read. He regarded every meeting of the company as adding an additional chapter to the history. They were taking advantage of the penalties their predecessors had had to pay, and of their experience. They had no doubt they would make

errors in the future by every new development. It was the directors desire to furnish the shareholders with all the information in their power. He did not believe in keeping anything a mystery, or making mysteries where they did not exist. At the recent meeting a set of accounts were issued which were criticised, he would not say adversely, or favourably. They were, however, practically of little value, excepting that they gave a knowledge of the general value of the undertaking, but nothing further. The Board of Trade had certain forms which had to be filled up at the end of the year, —the year ending December 31st—those accounts had now been sent to the shareholders, and he did not know that any improvement could be made in them. He expressed great regret at their having lost a valued colleague in the late Duke of Marlborough. Hon. Alan Charteris had not yet recovered from his illness, but they hoped he would soon do so. He placed before them a few statistics. They might go into them more carefully when in print, and see what the future prospects were likely to be. In the half-year ending December 31st, £95,939 had been spent on capital account, of which £16,070 was for machinery and plant; public lighting, £8,176; office furniture, management, and general expenses came to £1,580; land and buildings, £19,169. That total extra £95,939 was to the end of last year; to April 12th the statement showed that the total ways laid were 427 miles; cable drawn in high tension 60½ miles, and low tension 35½ miles. The number of lamps which were applied for during the six months ending December last was 21,000 8-C.P. lamps, number connected during that period about 8,400. The additional plant that was now down had enabled the company to connect 18,000 lamps since the beginning of the year, which result was very satisfactory; that was to say, that in the last three months they had supplied double the number they had done in the six months of last year, the total number being supplied from the company's mains was 38,200. It must be borne in mind that the supply of current had been a source of great anxiety, the demand had been continuous, and they were running well at the pioneer station, which the company took over when formed, but in order to get over some of their difficulties they had ordered, and had now in position and running, two large half units, which supplied each of them 6,800 8-C.P. lamps, that was, between 12,000 and 14,000 extra 8-C.P. lamps could be supplied more than with the pioneer station running by itself. Those units were now assisting that station, so that a good deal of that trouble with which they had had to contend—everybody grumbling because they were not put on first—was being sobered down by degrees. Those half-units were driven by means of ropes which was not by any means the best method; the permanent machinery to be erected would all be driven direct. The board could not possibly get those direct driven machines in time to meet the demand. There were some very large units on order from the Brush Company, also from the Laing, Wharton & Down Syndicate; of the first two large ones the first had been completed and tested at their works. The final results were not yet known to the directors, but they were very well as far as could be observed at the time. In six weeks the other would be at their station running or ready to run. Those machines would give a supply of current for something like 14,000 8-C.P. lamps. The Laing-Wharton Syndicate were to supply two large machines which he (the chairman) understood were now ready in America. They were made there, but very shortly they hoped to have them landed at the works. With those they would be able to supply at any rate 130,000 if not more, 8 C.P. lamps. If they went on as they were doing now, without any further troubles, no doubt they would be able to meet what they now tried to promise. The board came to the conclusion, after mature consideration, that it would be advisable to give up the station at Wool Quay. It would have been a very expensive station to construct the machinery for, as a large amount of it would have been under water level, and they would probably have to pump continually to keep the place dry. It was an inconvenient place. It would not be economical to have two stations, one at Bankside and one at Wool Quay, so they were moving the latter one to the side of the one at Bankside, and hoped it would meet with the shareholders' approval. After referring to some very interesting diagrams on the wall, and making further remarks, he moved the adoption of the report and accounts.

This was agreed to, the retiring directors (Mr. Braithwaite and Mr. Reynolds) were re-elected, also the auditors, Messrs. Pannell & Co.

[We shall print a full report of the meeting in our next issue.]

Elmore's French Patent Copper Depositing Company, Limited.

THE directors' second annual report reads as follows:—"Herewith we beg to send you accounts made up to December 31st last. From these you will see that the total amount of working capital the company has had at their disposal at the date of the balance-sheet from shares and debentures, after paying for patents, has been £140,061. In addition to this the company have had upon second mortgage £39,353, and from loans the sum of £28,739, and have incurred further liabilities amounting to £21,761. This sum has been expended as follows:—1. Cost of land, buildings, plant, furniture, stock, cash in hand and other assets, £169,458. 2. Expenses of issue of preference capital, £3,384, which would, in the ordinary course, be spread over a series of years. 3. Expenses up to May 31st, 1892, connected with the establishment of the company, the working out in the laboratory and works of the details of the process and alterations connected therewith, and in connection with the new patents taken out by the company, £18,483, the major portion of which could be either put to capital account, or the whole extended over a series of years. 4. Administration charges in Paris and London up to May 31st, 1892, which might be spread over a term of years, but which it would be more prudent to write off at once, namely, £14,416. 5. The amount paid by the company as interest and commission, £4,165, after deducting interest received on deposits, £609, which must be written off. 6. With regard to the bonus credited, but not yet paid, to the foreign company, namely, £3,000, this the directors hope will be waived. 7. The remaining items for rent of water-power and loss by exchange on sending money to Paris amount to £1,256. The profit and loss is taken from June 1st to December 31st, 1892, which is the time that the company has been at work regularly. It may be recollected that Sir Frederick Bramwell and Mr. Harris estimated that 12½ tons per week would pay all expenses. Owing to the small output during this period, namely, about 7 tons per week, the loss in manufacturing amounts to £5,187. Of this there is a certain amount of copper existent in the furnace bottoms, which is recoverable when these furnaces are ultimately taken up, though in the accounts treated as loss. The total administration expenses in France during this period amount to £2,972, and in London, £2,427. These charges are increased beyond the normal by incidental expenditure and professional charges, travelling expenses, &c. The amount of interest and commission comes to £4,884 for the same period, whilst the interest on debentures comes to £1,750, and the rent of water-power at Bellegarde £1,687. The directors consider that in normal working the administration charges in Paris and London ought to be covered by £5,000 per annum, unless the business is carried on on a much larger scale than is proposed. Naturally at the outset of the company heavy expenses have had to be incurred under this head.

BALANCE SHEET, December 31st, 1892.

	£	s.	d.
To Share capital authorised—100,000 ordinary shares of £2 each, £200,000; 100,000 preference shares of £2 each, £200,000	400,000	0	0
„ Ordinary share capital allotted—33,250 shares of £2 each allotted to the vendor company in part payment, £66,500; 66,750 shares of £2 each subscribed, £133,500; less calls in arrear (since paid), £234 14s.	199,765	6	0
„ Preference share capital allotted—21,891 shares of £2 each, upon which has been paid ...	42,788	10	0
„ Six per cent. redeemable mortgage debenture stock issued (Note—Debenture stock for £11,900 is temporarily lodged with creditors as security for loans)	38,000	0	0
„ Premium on issue of 66,750 ordinary shares ...	33,375	0	0
„ Receipts on shares before forfeiture	8	0	0
„ Bills payable—In France, £1,132 11s. 1d.; in London (including accommodation bills for £5[illegible]0), £8,763 13s. 2d.	9,896	4	3
„ Creditors—In France—Final instalment of purchase-price of land at Dives, due December, 1893, £1,485 3s.; sundry firms for work done and materials supplied, £6,279 11s. 6d.; caution-money deposited with the company, £118 16s. 3d. In London—Elmore's Foreign and Colonial Company, Limited, for balance of loan, interest, bonus, &c. (secured by second mortgage), £39,353 9s. 3d.; sundry loans and interest (of which £8,000 is secured by a temporary deposit of the company's debentures for £11,900), £26,739 19s. 9d.; loan (secured by charge on part of the copper stock), £2,000; sundry persons for balance arising from debentures surrendered, agreed to be paid off by issue of preference shares, £2,500; quarter's rent to date of water-power at Bellegarde, £750; debenture interest, £1,550 15s. 5d.; fees of directors and salaries, £784 0s. 2d.; sundry firms for professional charges, patent fees, printing, stationery, &c., £897 8s. 6d.	82,459	3	10
	£406,292	4	1

	£	s.	d.
By cost of patents (including premium of £33,375 received on issue of original share capital, per contra) £183,375; less sale of license to manufacture copper pans, &c., in France, after deducting commission of £500, £9,500	173,875	0	0
„ Cost of six acres of land at Bellegarde ...	5,270	0	0
„ Works at Dives—land, buildings, plant, machinery and furniture	137,263	18	4
„ Office furniture—Paris	521	18	6
„ Payments to contractors, now the subject of litigation for recovery or for value	482	0	0
„ Bills receivable—France	7	2	8
„ Debtors—in France, for tubes, &c., supplied, £1,651 7s. 2d.; in London, £968 12s. 10d.	2,620	0	0
„ Stocks—copper tubes manufactured and in course of manufacture, £15,636 0s. 9d.; freight &c., on tubes sent to depôts for sale, £446 8s. 8d.; materials and stores, £5,403 1s. 5d.	21,083	8	10
„ Cash—in hand at Paris and at Dives, £1,001 2s. 7d.; on deposit at Credit Lyonnais, Paris, as a guarantee, £990 2s.; in banks at London, £210 14s.; in hand in London, £8 10s. 3d.	2,210	8	10
Carried forward	£343,333	17	2

Brought forward	£343,333	17 2
By Expenses on issue of preference share capital	3,384	9 7
„ Items unresponded to by Paris office	88	11 10
„ Expenditure for experimental purposes, perfecting of process, administration and interest charges, &c., from incorporation of the company to May 31st, 1892—Experimental work in Paris laboratories, and in London, £2,957 5s. 5d.; first establishment charges, Paris, £1,229 8s. 11d.; first establishment charges, Dives, including cost of experimental working in April and May, 1892, £14,296 7s. 1d.; first general administration charges, Paris, £6,486 5s. 5d.; first general administration charges, London, £7,931 9s. 2d.; interest and commission, after deducting interest received from deposits, &c., in London and Paris, £4,165 7s. 11d; bonus credited to Elmore's Foreign and Colonial Co., Limited, in part consideration of advances, £3,000; rent of water power, Bellegarde, to May 31st, 1892, £750; exchange differences on remittances, £506 1s. 3d.	41,322	5 2
„ Profit and loss account—Balance at date ...	18,163	0 4
	£406,292	4 1

Note.—All conversions have been made at the rate of 25 fr. 25 c. to the £.

We have audited the books of the company in London and Paris (the latter including the certified return from the Dives office, which we have not visited), and we beg to report that the above accounts are correctly prepared therefrom.

The invoices for expenditure in France should be certified by Mons. Secretan, the Director-General, as an indication of his approval of the prices charged. To this and to other matters connected with the audit detail we have reported to the directors.

The debtors' balances, London, are of doubtful value, and include an item of £900 that appears to be of an accommodation character.

Deloitte, Dever, Griffiths & Co.,
4, Lothbury, London, E.C., *Chartered Accountants, Auditors.*
April 4th, 1893.

Manufacturing Account (Dives), from June 1st to December 31st, 1892.

Kilos.	Tons.		£	s.	d.
		To Stocks, June 1st, 1892:			
339,424	334·41	Raw copper and tubes manufactured and in process of manufacture, £17,764 1s. 1d.: sulphate of copper, £2,691 3s. 7d.	20,455	4	8
28,427	28·00	„ Copper, £1,291 16s. 1d.; freight and brokerage thereon, £36 11s. 2d.; sulphate of copper, £692 17s. 6d.; charges on ditto, £211 9s. 6d.; wages and salaries, £5,968 14s. 6d.; fuel and stores used, £3,484 2s. 3d.	11,685	11	0
367,851	362·41		32,140	15	8
		Less—			
		Stocks, December 31st, 1892—			
252,871	249·13	Copper manufactured and in process of manufacture, £15,636 0s. 9d; sulphate of copper, £3,416 2s. 5d. ...	19,052	3	2
114,980	113·28		£13,088	12	6
68,116	67·11	By Sales of tubes	5,583	1	1
29,220	28·79	„ Sales of scrap	1,461	4	5
			7,044	5	6
		Less—			
		Carriage and packing charges	165	10	8
			6,878	14	10
624	·61	„ Sales of argentiferous deposits, less expenses—£6 1s. 9d. ...	1,022	11	7
97,960	96·51				
17,020	16·77	„ Copper in furnace bottoms, and deficit			
		„ Balance—Loss—carried to profit and loss account (below) ...	5,187	6	1
114,980	113·28		£13,088	12	6

Profit and Loss Account from June 1st to December 31st, 1892.

	£	s.	d.
To manufacturing account—loss at Dives (as above)	5,187	6	1
„ Expenditure in France, including cost of administration in Paris (as above)	2,972	12	10
„ Expenditure in London (as above)	2,427	5	7
„ Interest on debentures	1,750	1	2
„ Interest and commission on loans	4,484	9	4
„ Rent of water power, Bellegarde	1,687	10	0
	£18,509	5	0

	£	s.	d.
By Rents of houses at Dives, let to workpeople ...	237	9	2
„ Transfer fees, London	83	15	6
„ Rebate on £100 debenture stock, redeemed ...	25	0	0
„ Balance—Loss—carried to balance sheet ...	18,163	0	4
	£18,509	5	0

An extraordinary general meeting of Elmore's French Patent Copper Depositing Company, Limited, was held on Thursday last week, at Winchester House, under the presidency of Major Jones, for the purpose of considering the following resolution, namely, "That it has been proved to the satisfaction of this meeting that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and accordingly that the company be wound up voluntarily."

The Chairman stated that the meeting had been called in fulfilment of an undertaking given by the board to an informal meeting of certain shareholders called by Mr. Saunders, M.P, and Mr. Storey, M.P. At the time of that meeting the board held the opinion—and it was still their opinion—that in their own interests the shareholders should unite and carry out the policy which they had advocated—namely, the issue of £100,000 new debenture stock, wherewith to pay off the existing debenture stock and to provide the necessary working capital for meeting the liabilities of the company and carrying on the work. Had that scheme been carried out, they would have been able to meet all their liabilities except the second mortgage to the Foreign Elmore Company and certain deferred bills, having a working capital left of something like £17,000, and it was not unreasonable to suppose that had they been able to do that they would have had sufficient credit to have borrowed an additional £20,000, so as to make the company a success. On the circular which the board sent out they had actually had £9,000 subscribed and a further amount conditionally promised, but unfortunately the action taken by Messrs. Saunders and Storey prevented any chance of their being able to carry that scheme through. The question at the present moment was—what was to be done? A petition had already been put upon the file for winding up the company, and this would come on for hearing on the 11th inst. It had been done by the London Loan and Finance Company, and since then Messrs. Maddison, acting on behalf of Mr. Wood (the largest shareholder), Mr. Heal, and others, had put in a receiver—Mr. Duncan, of Coleman Street—who was at present in the possession of the company's books. The Chairman then asked Messrs. Storey and Saunders to give the meeting their views as regarded liquidation.

Mr. Storey, M.P., thought it was the duty of the chairman to propose the resolution of which the directors had given notice.

The Chairman pointed out that the proposition emanated from Mr. Saunders and Mr. Storey, and that the directors had called the present meeting at the request of the meeting recently held. The board certainly did not undertake to recommend voluntary liquidation to the present meeting.

Mr. Storey retorted that he had come to the meeting, as a shareholder, to hear what the directors had to say. He then drew attention to a circular issued from the office of the company on the 28th ult.—the date of the issue of the notice of the extraordinary meeting—in which the directors stated that they believed the best thing for the company would be to go into voluntary liquidation for the purpose of re-construction.

Mr. Maddison, who said he represented Mr. John Wood, one of the largest shareholders, and Mr. Heal, remarked that since the last meeting the first named gentleman, acting under his advice, had appointed Mr. Duncan receiver. Mr. Duncan had been to Paris to ascertain the position of affairs, which was not so desperate as the shareholders generally imagined. Mr. Squire, chemical engineer, had also been to see the works, and a telegram just received from him said:—"Carefully studying works here; delay decision till my return if possible." In view of that, and also in view of what Mr. Duncan would say, he urged the Board not to hurry forward the liquidation of the company. As to the petition to be heard on the 11th inst., he hoped that arrangements could be made to postpone it, and for that purpose he suggested that the meeting should be adjourned until the 10th inst. M. Secretan's offer, he believed, was subject to certain conditions, and at the present moment he was not in a position to make a firm offer.

Mr. Duncan said that upon going to Paris he found that the company was in an exceedingly critical financial position. There was a threat made on Good Friday that the French liquidator would take possession of everything, and this, if carried out, would put them in a very disastrous position, and would mean a deadlock with regard to the working of the process for almost an indefinite period of years, unless they were fortunate enough to find someone who would pay a large sum for the works and take them over at once. That, he was afraid, was not very much on the cards. On the other hand, as far as orders were concerned, he could say that there was dis inct encouragement on the other side. Upon going through the order book he was surprised to find the quarters from which the orders were received, for they came from some of the very best engineering firms in France, although some of the largest orders had had to be refused by M. Secretan, because he had not the copper to convert into tubes. He met some French shareholders and asked them what kind of reputation the business was enjoying in Paris, and their answer was that the financial position was absolutely bad, while as to the industrial commercial position, nothing could be better. That was to say that, as to orders and business to be got, the establishments in France, who were their customers were prepared to trust them for the quality of their manufactures. The question now was, how was the situation to be saved here? From the information he had obtained on this side,

prospects of raising capital here did not appear hopeful; in carrying on a company of this description a large working capital was absolutely essential. Upon coming to the conclusion that it was of no use whatever to try to work the company on a small scale, he saw M. Secretan about the offer he had made to the company, which was much better than the offer he had previously made. That, however, did not seem to him to be sufficiently good, but he thought he was in a position to say that if the meeting authorised the negotiations, there were people behind M. Secretan in Paris who would agree to a proposal. First of all they would form a French Company with a capital of about £80,000 or £100,000, out of which they would pay £20,000 to the English company, with the view of getting rid—and on condition that the company did get rid—of all liabilities in France, which, at the present moment, amounted to about £7,000 or £8,000. That would leave something over, with which arrangements would have to be made. They would then give £60,000 of French debentures, which would be issued at 5 per cent. at a discount, so as to yield 6 per cent. here. In addition, they would give £60,000 of founders' shares, to rank after the working capital raised in Paris, and that was the point on which he told M. Secretan there was no use talking over the matter unless he could get his friends to improve their offer. His friends were to take 10 per cent. of the profits, and to divide what remained with the English shareholders. He (Mr. Duncan) said the old shareholders must be allowed to have 10 per cent. immediately after the working capital had had its 10 per cent., and he thought M. Secretan was now prepared to agree to that suggestion. After that the surplus profits would be halved. He thought negotiations like that could soon be brought into shape. He believed that in the name of a French concern, backed by important French capitalists interested in the firms who would be customers, success would be far more possible and certain than if an attempt were made to continue in the name of the present company and with the management in London. If they went into liquidation they would have a great deal of trouble in giving effect to anything coming out of those negotiations, but if they could keep the company alive to settle with their creditors, he thought the company could be resolved into something like a simple trust, worked at a nominal figure in London. The debentures would have their rights and the preference shares their rights, and if M. Secretan's figures were correct, the shareholders would see in the course of a year's time something like 6 per cent. upon the ordinary shares. He had asked the Board to consider whether they could hang up the question of liquidation for a time, as although he did not think a signed agreement could be obtained by Monday next, there might be something to report to the shareholders which would be of a more definite character than what was brought forward on the present occasion. It was suggested that there should be five directors in France, of whom two should be English.

Mr. STOREY, in commenting at some length upon the proposal laid before the meeting, said the suggestion seemed to him that everything was to be handed over to the French Company—the works, their control and the possibility of making a percentage—and that it appeared that if ever they were fortunate enough to get 10 per cent. upon their interest in the new company, which worked out at £17,000, it would mean a return of something like 1½ per cent. upon their present holdings. In further remarks the speaker strongly advocated voluntary liquidation for the company under the protection of the Court, urging that in that position they would be better able to negotiate for any sale of the property.

After some remarks from Mr. F. L. RAWSON, the proposal to adjourn was seconded by Mr. FREEMAN, and after some further discussion,

Mr. SHURMER (the Secretary) read a communication which he had received from Sir Thomas Farrer, who had stated that Mr. Foster's report was quite as satisfactory as he had anticipated, and advocated a thorough overhauling of the financial affairs of the whole of the Elmore companies, and not of the French companies alone. The speaker then proceeded to suggest a course by which the company might have the use of £40,000 actual cash advanced without interest, and which would have the effect of reducing the total share capital from £240,000 to £140,000, and he thought that if the concessions which he suggested were made, it would not be too much to ask the shareholders to subscribe the balance of the debenture stock recently offered by the company, and of which £9,500 had been applied for. As to the claims of creditors, he was certain that he could get many of them waived altogether, while those of other creditors would be satisfied in shares or debenture stock. It would be much better for them to subscribe this money, and make the company a thorough success, than let the property get into the hands of French capitalists.

Mr. SAUNDERS, M.P., said he considered that the proposal to liquidate the company voluntarily was the only one which offered the slightest chance of any good results being obtained for the shareholders. He proposed, as an amendment, that the company should be liquidated voluntarily under the supervision of the Court.

Mr. BARTWELL seconded the amendment, but—

The CHAIRMAN ruled it out of order, stating that the resolution of which notice had been given could not be put as an amendment.

Mr. MADDISON said that since the commencement of the present proceedings he had received another telegram from Mr. Squire as follows:—"Pity to let things smash, but decline to pronounce hurried opinion before complete investigation. So far favourably impressed."

Mr. SAUNDERS having commented upon the high rate of interest which the directors were paying on bills which had been renewed,

Mr. CROFT asked what interest the firm of Woodhouse & Rawson held in the company?

Mr. F. L. RAWSON replied that Woodhouse & Rawson United, Limited, had £250 in shares, and, speaking from memory, he thought they made £5,000 out of the formation of the company.

Mr. STOREY then entered a formal protest against the action of the directors in not having placed the proposal to liquidate before the meeting as a substantive motion, and ultimately the motion for the adjournment of the proceedings until Monday next was agreed to by a large majority.

At the meeting held on Monday, the only director present was Sir James Mackenzie, who presided.

The CHAIRMAN—after apologising for the absence, through illness, of Major Jones, the chairman of the company—said the meeting had been adjourned so as to consider further the prospects of the company as opposed to voluntary liquidation. On the previous occasion it was considered by the minority that the only way to save the company at all was by liquidation, but he did not think it was fully understood by those gentlemen what would be the effect of that decision in France. From what the French lawyers told them the directors knew that even the interests of the debenture holders would be most seriously damaged, and at the present moment it would really be a disastrous step to take. An objection was raised at the last meeting to the effect that the board had nothing definite to lay before the shareholders. Mr. Duncan, who then addressed them, had, however, just returned from Paris, and had succeeded in getting something definite to place before them.

Mr. DUNCAN said he did his best to come to some arrangement with M. Secretan by letter and telegram, but finding this impossible, he went to Paris and saw that gentleman. He had brought back something in the form of a definite and firm proposal, although in one or two matters of detail it was not quite so good as he sketched at the previous meeting. The following letter from M. Secretan made the proposal a firm one:—

"In presence of the present grave financial position, and with the object of avoiding an irremediable catastrophe, I beg to offer to undertake the following negotiation. I propose to buy all the assets of the company in consideration of the following:—(1) £60,000 in first mortgage debentures in payment of the present mortgages entitled to receive £4,000 per annum, interest and sinking fund included. (2) £20,000 in cash within three months, in order to pay off the creditors; £10,000 thereof for the English creditors and £10,000 for the French creditors. (3) £60,000 in founders' or ordinary shares to be given to the English holders. I would raise a new capital of £100,000 of which £80,000 would be represented by cash and £20,000 by fully-paid shares, to be given to the French shareholders and founders. Of the £80,000 to be subscribed in cash, the right of subscription would be reserved to the present English shareholders up to one-half of the amount, £40,000, if they so desire. If this proposal, which I only make with the object of saving the Elmore Company from a disaster caused by its financial position, for which I am not responsible, is accepted, I have no doubt of being able to give effect to it. If this proposal is accepted the present company would be transformed into a French commandite company, under the name of E. Secretan & Co. As soon as I receive your reply in this sense, I will have the articles of the new company drawn up, and will submit them for your examination. It is understood that the payment of £140,000 above mentioned would entitle the new company to all the assets without exception or reserve, and that in consideration of this payment the present company would have to make its own settlement for all liabilities without exception or reserve."

Accompanying that letter was the following:—

"I beg to send you herewith the new proposals regarding the reconstruction of the Elmore French Company—proposals which we have together discussed to-day, and which, if they are accepted by you and by the general meeting, I undertake to get accepted also by my friends, subject only to the understanding (1) that you give me the reasonable time necessary to give effect to them, and (2) that you furnish me in the meantime with the means of keeping the factory going until the end of May if necessary. In my scheme I shall reserve one-half of the subscription for my friends in England, this option to be declared not later than the 25th inst."

M. Secretan had since written:—

"In the proposal which I had the honour to send you yesterday, I made an omission, which I now beg to correct. The Board of Supervision of the new company would be composed of five members, of which two would be the representatives of the English interests. These have been agreed between us, and I beg to confirm it. I wish very much that the representatives of the English interests should be chosen from amongst the most competent men you can command, and if my experience may be taken as a guide, one of these representatives ought to devote himself more especially to the business details of the affair, the other ought, if possible, to be a chemical engineer of good position who would take up more especially the technical side of the business. In this way, not only would the general interests be better protected, but I would find in my board, composed of competent men, a real support, which would be exceedingly useful, and which I desire sincerely."

Explaining various points, Mr. Duncan stated that of course a formal contract still remained to be drawn up. If, however, the shareholders did not throw any difficulties in the way, he felt sure they would be able to give complete effect to these arrangements. Some time must necessarily elapse before a final settlement could be arrived at, and this would entail some loss in the process of keeping the factory at work. In addition, he found that the list of creditors in France was somewhat larger than he had anticipated. Consequently he had allowed a slight increase upon the sum to be dedicated to the extinction of the liabilities on the other side, making the amount £10,000 instead of £8,000, on condition that the new party would take over absolutely and entirely not only all risk of paying off creditors there, but also all loss that might accrue until they were ready to take over the business. When he told them the other day that they would get £60,000 first mortgage debentures entitled to 6 per cent., thus giving them £3,600 a year, he was under the impression that that would be payable to them by way of interest, whereas, as a matter of fact, the purchasers meant 5 per cent. interest and 1 per cent. sinking fund. They had compromised that by agree-

ing to give them £4,000, which would be about 5½ per cent. interest and ½ per cent. sinking fund. As to ordinary and founders' shares the French people were prepared to give them, not 10 per cent., but 7½ per cent., after they had received 10 per cent., the surplus being equally divided. The French had very sound ideas with regard to reserve, and the group proposing to purchase the company's property intended to put 5 per cent. of the profits to reserve in the first place. Again, M. Secretan was willing that his salary should be £800 a year, and 10 per cent. of the profits instead of 20 per cent. of the profits without any fixed sum as under the original agreement. Considerable discussion took place as to the reserve after the 5 per cent., and as the matter now stood 10 per cent. of the profits after the shareholders had received their 7½ per cent. would go to that fund. Making some allowance for having to settle with creditors on this side, and entertaining on the other hand an expectation that they would be able to make favourable arrangements with the vendors as to their interest in the company, he thought that an outturn of 150 tons per month would show two or three per cent. on the ordinary capital of the French Elmore Company, while 200 tons would mean 6 or 7 per cent. He was sorry to say that on this side they had not yet got rid of the creditor who was petitioning the Court, and the first necessity was to make some arrangement with regard to that matter, as it would be extremely difficult to keep the thing going in France if anything in the shape of liquidation should supervene here. The appointment of a liquidator in France would immediately stop the working of the company.

Mr. STRETTELL, who pointed out that every expert and every inquiry at home and in France declared the process to be eminently sound and successful, placed an alternative scheme before the meeting, based upon a fresh subscription of capital by both shareholders and public. Were the shareholders, he asked, going to lose their just reward on the very eve of success by their own apathy and by their distrust of the past management?

The CHAIRMAN then called upon

Mr. SQUIRE, who was a member of the committee of the English company on account of his long technical experience of chemical manufactures. He took a scientific interest in the process as well as being a small shareholder in the English company. He went over to Paris to investigate, and M. Secrétan went down to the works with him and explained matters. He found the works exceedingly well put up, and there was really nothing that could fairly be called extravagance. The process was working on a very small scale, but was working well. There was no doubt that M. Secretan had considerably improved the process from what it was at first; it was decidedly an improvement from Mr. Elmore's original proposals. They could not make 150 tons of tubes per month at the present time. As to the price that could be got for the tubes, it was a mistake to suppose that in every case a higher price could be obtained for the Elmore made tubes than for the ordinary tubes. It was so stated in a good many of the prospectuses, but that was not the fact. He was pretty well satisfied that the process was a cheaper way of making tubes than the old process. As to the cost, the work had been so extremely irregular at Dives and on so small a scale that it was not fair to take the cost as representing the cost which would actually take place in practice if the works were carried out on a considerable scale. Everything depended so very much on the management. M. Secretan was an extremely able man, and would be able to work the business exceeding well, if they only had a good control over him. He was apt to be an extremely sanguine person; his horizon was almost boundless; he wished to apply the process to making iron tubes and aluminium tubes. Mr. Squire said he was perfectly convinced that he could not do one or the other. If they kept him from making experiments, and kept him absolutely on his work, the process was in a position to furnish them with tubes of excellent quality, for which they could get a fair price, but not an extraordinary price. If they accepted M. Secretan's proposal the prospects of the concern were very fair. At the present time if he was going to run the affair himself he would not mind buying plenty of shares in it; but if it was going to be run by a lot of amateurs he would not have anything in it.

Mr. WOOD, at whose instance Mr. Duncan was appointed receiver, pointed out, in the course of some discussion, that unless before the shareholders left that meeting they were prepared to deal with the petitioner before the Court in some way or other, the negotiations between Mr. Duncan and M. Secretan would be jeopardised.

Mr. STOREY, M.P., suggested that the directors, for whom the company appeared to have been worked, and who had so mismanaged affairs, should pay off the creditors who were petitioning the Court. If something were not done the concern would go into bankruptcy, and the English shareholders would then be absolutely powerless. It was surprising that the directors had not brought forward a proposal, and if they could not now suggest anything, the best plan for them would be to waste no more time but go home and let the lawyers and others who had the matter in hand go on with the work and make a good deal out of the business.

The CHAIRMAN remarked that if Mr. Maddison (representing the receiver) was successful in making arrangements, the petitioning creditor would be staved off, but if he were not they had no alternative but to pass the resolution for voluntary liquidation.

Some further discussion took place, and an adjournment until a later hour in the afternoon was ultimately agreed upon.

When the shareholders re-assembled Mr. MADDISON said he had seen the solicitors of the petitioner, and had found that there was a second bill for £250 behind the first and a further sum of £64 behind that. Through the assistance of Mr. Wood, Mr. Heal, and other gentlemen they had settled the matter satisfactorily to this extent—that the other side would agree to adjourn the petition for four weeks from Saturday next. He asked that the meeting should be adjourned for four weeks, so that, assuming everything was arranged satisfactorily, matters would then be announced as settled. If that were not so, they would still be able to appoint a liquidator before the petitioner could get one appointed, which would be on the following Saturday.

After some discussion it was resolved: "That this meeting, taking favourable note of the proposal of M. Secretan, stand further adjourned until May 8th, at two o'clock, at Winchester House, and that a committee be appointed to confer with Mr. Duncan as to the best method of carrying out the arrangements with M. Secretan, or otherwise doing what is best for the interests of the company.

The committee apointed consisted of Mr. Storey, M.P., Colonel Shepherd, Mr. Strettell, Mr. J. Wood, and Mr. J. Heal.

Elmore's Patent Copper Depositing Company, Limited.

REPORT TO THE SHAREHOLDERS BY THE SHAREHOLDERS' COMMITTEE.

As a committee appointed by the shareholders at the general meeting held March 16th, 1893, we have been engaged in an examination of the books and transactions of the company, and have inspected the works at Leeds, in company with Mr. Owen Jones, C.E., who has aided us materially in making an estimate of the condition and value of the works and the efficacy of the process of manufacture. We find that the promoters took the lion's share of the money paid for the purchase of patents, &c.; that the vendors' shares were divided practically between the present directors (excepting Messrs. Hooley and Johnson); that, in fact, the Messrs. Elmore have received only a very small proportion of the purchase price, either in money or shares. We find that the sale of the license to the Wire Company gave a nett sum of £103,675 10s. 9d. to this company, of which only £20,000 was written off the original purchase money and £70,000 divided in a dividend of 50 per cent., the then directors taking a sum of £3,930 13s. 1d. as their share of the profit. (Altogether the directors have been paid £9,182 2s. 11d.) We consider that it was most imprudent and suicidal to distribute this large sum, which in our opinion was wrongly credited to income. We find that the company in 1890 entered upon a land speculation, purchasing Haigh Park for £67,887 16s. 8d. This transaction has helped naturally to hamper the finances of the company. (Mr. Gore's report on the land will be read to the meeting on the 7th proximo.) We find also that £11,938 9s. was expended in the market purchase of shares in the Wire Company, presumably to bolster up the market, and that this is treated as a good asset in the balance-sheet, although the shares cost about £4 each. We find that the defects in the engines, the leakage in the tanks, and the difficulties with the iron mandrels were the main causes of delay in the manufacture. The committee find that there are present liabilities of £7,327 14s. 3d., besides a mortgage of £35,000 on the land, and a contingent liability of £1,000 on an acceptance of the Wire Company, discounted at the rate of 20 per cent. per annum. There is also a sum of £4,000 required to complete the needful machinery, and a further sum of £1,600 unless the buildings, &c., used jointly with the Wire Company continue available. (Messrs. Jones and Davidson's report on these points will be read at the meeting) There is (by the works' account) a stock of finished tubes of a sale value of £5,569 4s., and raw copper in the tanks, &c., of £2,487 11s. 10d., together £8,056 15s. 10d. We saw tubes in every stage of manufacture, and they appear perfect in every way. We examined into the orders received and those executed, and were gratified in finding that customers come again with frequency, and that there seems always a sufficiency of orders on the books for more than the present output. There has been produced since July 1st, 1892, only 102 tons of tubes, and by the detailed accounts rendered of cost and prices of sale there is apparently a gross profit of about £14 per ton on the manufacture; but as this is at the rate of only about 1½ tons per week, the cost is naturally much more than it would be were the factory working up to its full capacity. At present the outturn looks like 3 tons per week, and it is stated that the present tanks at full work will produce 20 tons per week. The machinery was being worked by electric motor (during the temporary removal of the engine owing to a giving way of the foundation), so that we were unable to make any investigation on this point. We believe that Messrs. F. Elmore and S. Elmore's services are of great value to the company. They have held all shares allotted to them, and increased their holdings, and we may say that all the directors have fully retained their original interest in the shares of the company. In conclusion, we are strongly impressed with the value of the business, and advise that a strong effort should be made to provide the means for carrying it on. We deem it advisable that a new board of directors (preferably local men) be found to conduct the affairs of the company, composed of men of good business capacity (including one engineer), otherwise that it would be needful, with a London Board, to have a managing engineer at Leeds, who would carry out their views, and report constantly to them on the state of the work and the finance of the company. We think that the needs of the business would be fully met by a sum sufficient to clear off liabilities, and give a clear £10,000 for the further purchase of raw copper, say £17,000 in all. This being done, we think that a satisfactory and profitable business would be quickly established, with, as a result, the reinstatement of credit and clearing away of future difficulties. We think that the launching of the Wire Company was a great mistake, and established a false financial position, also that the prices of the licenses and of the land sold to the Wire Company were unreasonable, and not justified by any evidence or examination, being practically a transfer from one board to another board consisting of nearly the same members. One means of raising the required capital is the issue, as 10 per cent. preference shares, of the 8,800 unissued ordinary shares, such shares to be cumulative as to dividend and preferential as to capital; and this commends itself to us, rather than other expedients, which would deprive the shareholders who are

willing to subscribe, of their first pull at the profits. With regard to the land, we advise, upon the authority of Mr. Gore—than whom there can be no better judge—that certain portions be put up for sale at once and disposed of so as to relieve the company of the charge of interest on the mortgage.

J. TODHUNTER.
A. PRITCHARD.
G. INVERARITY.
JOHN WEBSTER.
J. Y. DAVIDSON.
S. W. GORE.

64, Cannon Street,
London, E.C., *March 29th*, 1893.

The accounts of the company, verified by an independent accountant, will be presented at the meeting on April 7th.

An extraordinary general meeting of Elmore's Patent Copper Depositing Company, Limited, was held at the Cannon Street Hotel, E.C., on Friday, the 7th inst., to receive the report of the shareholders' committee appointed on the 16th ult., and to take such action thereon as may be deemed advisable, and to consider, and if thought expedient, to pass the following resolution, in accordance with the recommendation of the committee:—"That the 8,800 unissued ordinary shares of the company be issued and called preference shares, entitling the holders thereof to a cumulative preference dividend of 10 per cent. per annum, the said preference shares to have preference, not only as to dividend, but as to capital in the final distribution of assets." Mr. J. J. Atkinson occupied the chair.

The SECRETARY having read the notice convening the meeting,

The CHAIRMAN said the meeting had been convened to receive the report of the shareholders' committee, appointed at an extraordinary meeting held the other day. He thought, himself, the chairman of that committee should have been in the chair that day, but he wished otherwise, so he should not detain them further than to ask that the report of the committee be read.

Mr. J. TODHUNTER (chairman of the committee), who rose to submit the report, said it had been in the hands of the shareholders, and it rested with him to explain rather more fully to the meeting than was done in the report what the committee had learnt in their investigation. In the first place, he wished to say that the committee had received every assistance, both from the directors and the managers of the works, and there had been no sort of attempt at concealment, and that every paper, report, and document had been placed at their disposal, so that if there was any defect in the report of the committee before the meeting, it was from their own carelessness, and not from any information that had been reserved. He would also say that it had been practically impossible for them, in the short space of time which they had had, to go absolutely into all the details of the business, but they thought that they had so far investigated the affairs of the company, that no important particular, either of the past career of the company, or of the present position of the company, had been passed over by them. He thought the best plan for him to follow would be to read the report paragraph by paragraph, making his comments on each as he went along. "We find that the promoters took the lion's share of the money paid for the purchase of patents, &c.; that the vendors' shares were divided practically between the present directors (excepting Messrs. Hooley and Johnson); that in fact the Messrs. Elmore have received only a very small proportion of the purchase price, either in money or shares." There he might explain that they had examined into the original contracts and agreements between the promoters and the vendors, and that, as a fact, Messrs. Elmore and their partners had received only the shares, and that the greater portion of the purchase money paid in cash went to the promoters of the company.

A SHAREHOLDER: Are we to understand that Mr. Elmore only received shares?

Mr. TODHUNTER: As far as we know. We can trace no money into their hands. The whole of the money was paid to the promoters. Whether the promoters paid back any of the money to Messrs. Elmore we do not know.

A SHAREHOLDER: Who were the promoters?

Mr. TODHUNTER: Messrs. Woodhouse and Rawson. (Laughter.) That is to say, that Messrs. Atkinson and Cooper were partners with Messrs. Elmore before the patents were sold, and the patents were sold by these directors to Messrs. Woodhouse and Rawson. That, gentlemen, was the position of the company in its first inception. We then come to the sale of the license to the Wire Company. "We find that the sale of the license to the Wire Company gave a nett sum of £103,675 10s. 9d. to this company, of which only £20,000 was written off the original purchase money, and £70,000 divided in a dividend of 50 per cent., the then directors taking a sum of £3,930 13s. 1d. as their share of the profit (altogether the directors had been paid £9,182 2s. 11d.). We consider that it was most imprudent and suicidal to distribute this large sum which, in our opinion, was wrongly credited to income." Perhaps that required some explanation. The sale of the license to the Wire Company was for £75,000, and the £2 shares were issued at £1 premium. Less the expenses, that company had received upwards of £100,000. The committee had failed to see that it was a right disposition of that sum to put it to profit and loss account. They had sold a portion of their property, and they thought a very large proportion of that should have been returned to capital, and not credited to income. That was merely an opinion, but that was what they considered it to be their duty to report to the shareholders. The sum which the directors had taken was in accordance with the articles of association, which provided that after the payment of 20 per cent. dividend the directors should take 10 per cent. of the profits.

A SHAREHOLDER: Do I understand that at the time this sale took place the directors were the same in both companies?

Mr. TODHUNTER: Practically that is so.

The CHAIRMAN: No, not when the company was floated.

Mr. TODHUNTER: The directors are the same now. Whether they were the same at the time of the sale I cannot tell. "We find that the company in 1890 entered upon a land speculation, purchasing Haigh Park for £67,887 16s. 8d. This transaction has helped naturally to hamper the finances of the company." Upon that Mr. Gore had made a more complete report, which would be read later on. There was no doubt, in the minds of the committee, that all those transactions were entered into with the idea that these companies were going to become enormous companies—companies of extraordinary magnitude, and the 50 per cent. dividend had no doubt been declared with the view of encouraging subscriptions to these other companies. It appeared to the committee most distinctly that the views of the directors were directed to the purpose of launching out those companies, rather than to the steady working out of the patents and the business of the company, and there had been a great deal of trouble and many mistakes made in consequence. That policy had been pursued in that purchase of land. The company had previously purchased seven acres of land at £750 an acre, which was ample for the purposes of the company. Yet it was thought necessary to buy further land for the purposes of the Wire Company, and as other land was not available except at a high price, that great land speculation was entered into for the purchase of the Haigh estate, saddling the company with an enormous estate in land—a land speculation which should never have been entered into, as the committee thought, by a manufacturing business, locking up, as it naturally did, a considerable portion of the company's capital; because, although a mortgage of £35,000 was obtained upon that land, the difference had to come naturally out of the capital of the company. Prudent considerations should have, it might have been thought, forbidden any such transaction, because it was evident, unless everything went on in a particularly propitious way, that the capital then subscribed of the company was totally insufficient for purposes of the company. Therefore they were locking up capital which ought to have been available for the business, the management of the company's works, and the development of the process.

A SHAREHOLDER: Do the articles of association allow it?

Mr. TODHUNTER: Oh yes; the articles of association are quite wide enough for that. (Laughter.) "We find also that £11,938 9s. was expended in the market purchase of shares in the Wire Company, presumably to bolster up the market, and that this is treated as a good asset in the balance-sheet, although the shares cost about £4 each." At the time of the launching of the Wire Company, it is undoubted that those shares in the Wire Company were purchased by the directors of the Elmore Company—the Depositing Company—on account of the company, and that those shares were still the property of the Depositing Company, having cost nearly £4 apiece, while being worth now—well, they knew what they were worth. (Laughter.)

A SHAREHOLDER: Do the articles of association cover that?

Mr. TODHUNTER: They would not cover the purchase of shares in their own company, but I believe there is nothing to prevent the purchase of shares in another company. Going on to another subject, "We find that the defects in the engines, the leakage in the tanks, and the difficulties with the iron mandrels were the main causes of delay in the manufacture." No doubt that had been the case, but he would say this, that in connection with the launching of those other companies, that the services of Messrs. Frank and Stanley Elmore, which were most valuable during the whole period of this company's working, had been transferred to France for the purpose of launching, or helping to launch, the French company, and he believed it was very much against their will that they were taken away from their work at Leeds, and sent over to France for some months. The consequence had been that it was only in August last year that the process had been practically completed, and the works made ready to turn out tubes in a perfect form. Well then, of course, the capital was gone. There was no money to buy copper, no money to complete the machinery, and, practically, the works had been only rolling on a very small scale ever since, and instead of 20 tons a week being turned out, there had been a turn out of about 1½ tons a week. "The committee find that there are present liabilities of £7,327 14s. 3d., besides a mortgage of £35,000 on the land, and a contingent liability of £1,000 on an acceptance of the Wire Company, discounted at the rate of 20 per cent. per annum. There is also a sum of £4,000 required to complete the needful machinery, and a further sum of £1,600 unless the buildings, &c., used jointly with the Wire Company continues available." He came to another point. The committee maintained that it was only for financial reasons that that Wire Company had been started at all, and that it never ought to have been started, because the two companies were so intimately connected that they must be worked as one company, and to show that that was the directors' own opinion, they found that various portions of the works were used jointly, and that unless the Wire Company's premises, or part of its premises, were still available for the Depositing Company, that the Depositing Company would have to erect other buildings in order to do those things which were necessary as a portion of its manufacture. For instance, there were the reducing furnaces. Those furnaces were on the Wire Company's premises, and there were no reducing furnaces on the Elmore Depositing Company's premises, and therefore if those furnaces on the Wire Company's premises were not available for the Depositing Company, the Depositing Company must necessarily erect furnaces for itself.

A SHAREHOLDER: At whose expense were the furnaces provided?

Mr. TODHUNTER: I am told that one of the furnaces belongs, practically, to the Depositing Company, but it is in the same building as the Wire Company's business.

A SHAREHOLDER: What are they for?

Mr. TODHUNTER: For reducing the ore into copper, but whether it is copper ore or bars, it has to be put through furnaces in order to come available for the tanks.

A SHAREHOLDER: I should think that the cost of a furnace of that kind would be a mere trifle.

Mr. TODHUNTER: It is stated that a furnace would cost about £800. Well, then the joint offices were on the Wire Company's premises. There are no offices on the Depositing Company's premises at all, and therefore the offices which are occupied by the Depositing Company's officials are not on their property. "There is (by the works' account) a stock of finished tubes of a sale value of £5,569 4s., and of raw copper in the tanks, &c., of £2,487 11s. 10d., together, £8,056 15s. 10d."

A SHAREHOLDER: Those are there?

Mr. TODHUNTER: Those are there. We cannot vouch for the value of them, because it is impossible to go into details. We had detailed accounts given to us, and we saw a large amount of tubing in store, and a large quantity of copper in the tanks, and we have no reason to doubt that that statement was correct. "We saw tubes in every stage of manufacture, and they appear perfect in every way. We examined into the orders received and those executed, and were gratified in finding the customers come again with frequency, and that there seems always a sufficiency of orders on the books for more than the present output." The present business was most successful in rollers for calico printing, and the orders for that kind of business seemed to come in frequently, while those who ordered once ordered again; but, as far as they were able to ascertain, it was not a very large business, and probably the whole demand for that kind of work would not exceed three or four tons a week. That was beyond the present capacity of the works, that was to say, more than the works were doing at present, but they believed that a very large demand would be established at once for steam tubes—copper tubes—if the company was in a position to supply regularly tubes of the required sizes. To do that it was very clear, as would be seen, from the engineer's report, that extra machinery was required. A drawing bench had been provided, but machinery for the working of the drawing bench would have to be got, together with various other testing machines, at a cost of about £4,000 or £5,000. Before the business could be taken up satisfactorily, the shareholders would have to face that outlay, before the tanks could possibly be worked up to what was stated to be a capacity of 20 tons per week. "There has been produced since July 1st, 1892, only 102 tons of tubes, and by the detailed accounts rendered of cost and prices of sale, there is apparently a gross profit of about £14 per ton on the manufacture; but as this is at the rate of only about 1½ tons per week, the cost is naturally much more than it would be were the factory working up to its full capacity. At present the outturn looks like 3 tons per week, and it is stated that the present tanks at full work will produce 20 tons per week. The machinery was being worked by electric motor (during the temporary removal of the engine owing to a giving way of the foundation), so that we were unable to make any investigation on this point. We believe that Messrs. F. Elmore and S. Elmore's services are of great value to the company. They had held all shares allotted to them, and increased their holdings, and we may say that all the directors have fully retained their original interest in the shares of the company."

A SHAREHOLDER: Were those shares purchased, or were they shares allotted.

Mr. TODHUNTER: They were shares allotted. There have been transactions in shares by the directors, but practically I think they hold the same number of shares that were originally allotted to them. I can give the exact number, but I think that is practically the case—that they hold the shares which were allotted to them.

A SHAREHOLDER: For which they paid?

Mr. TODHUNTER: No, they did not pay for them. They were founders' shares. He thought he might express the opinion of the committee that Mr. Frank Elmore and Mr. Stanley Elmore had worked most assiduously in the interests of the company, and they had a very high opinion as to the value of their services. They believed that they had most distinctly acted in good faith towards the company in every way. They had not only held all the shares which had been originally allotted to them, but they had on every opportunity increased their holding in the company. "In conclusion, we are strongly impressed with the value of the business, and advise that a strong effort should be made to provide the means of carrying it on. We deem it advisable that a new board of directors (preferably local men) be found to conduct the affairs of the company, composed of men of good business capacity (including one engineer), otherwise that it would be needful with a London board, to have a managing engineer at Leeds, who would carry out their views, and report constantly to them on the state of the work and the finance of the company." The committee had very carefully considered the question, and they were not prepared to lay down any hard and fast rule about that. They thought it necessary there should be an engineer who should periodically confirm the work that was done by Messrs. Elmore, but they were not unanimous as to a resident engineer being necessary. There was at a former period of the company's history a resident engineer, and that certainly had caused an immense amount of friction at Leeds, and the committee preferred that that should be left as an open question to be decided by any future board they might appoint. "We think that the needs of the business would be fully met by a sum sufficient to clear off liabilities and give a clear £10,000 for the further purchase of raw copper, say £17,000 in all. This being done, we think that a satisfactory and profitable business would be quickly established with, as a result, the reinstatement of credit and clearing away of future difficulties." They thought that working up to the capacity of 20 tons a week, that that sum would probably be about sufficient, and they did think that there would practically be no doubt that with that the company would be worked at a very good profit, and for his own part he strongly was of opinion that shareholders ought not to allow the business to lapse, but that they should provide that small amount of capital in order that what they were convinced was a good business should not be thrown away. He had no doubt there were plenty of people waiting to pick up that business at a low price, and that fortunes would be made out of it some of these days. For his own part, he thought it would be a very great pity if the shareholders who had subscribed such a large sum of money, and which had been wasted and squandered to a very large extent, should allow, at the eleventh hour, the business to pass into other hands, rather than subscribe a further small amount of money to put it on a safe footing. "We think that the launching of the Wire Company was a great mistake, and established a false financial position, also that the prices of the licenses and of the land sold to the Wire Company were unreasonable, and not justified by any evidence or examination, being practically a transfer from one board to another board, consisting of nearly the same members. One means of raising the required capital is the issue, as 10 per cent. preference shares, of the 8,800 unissued ordinary shares, such shares to be cumulative as to dividend and preferential as to capital; and this commends itself to us, rather than other expedients, which would deprive the shareholders, who are willing to subscribe, of their first pull at the profits." Their present directors had exhausted every means of raising money upon debentures and other means, and it would, in the committee's opinion, be futile to seek to raise outside capital to carry on those works, so that the position remained practically this—that either the shareholders must find that money, or the thing must go into liquidation. He thought the money should be provided by the shareholders, but conditionally that the business must not be used as a speculative machine, but conducted on sound business principles.

A SHAREHOLDER: Can we get rid of the old directors?

Mr. THOMPSON COOPE: They are only too anxious to go. (Laughter.)

A SHAREHOLDER: When they have got their share of the swag.

Mr. TODHUNTER: I think the directors have exhausted the patience of the shareholders, and it is absolutely necessary to have a new board.

A SHAREHOLDER: Cannot they be compelled to disgorge some of the money.

Mr. TODHUNTER: I understand they are willing to waive all fees due to them. (Laughter.)

The supplementary reports having been submitted,

The SECRETARY read the report of Mr. Spencer W. Gore on the company's landed estate, a director remarking that Mr. Gore had had very extensive experience of valuing land and property in manufacturing towns. The report stated that the land was acquired at a fairly reasonable price, £500 per acre, and that adjoining land had been sold to a gas company at £600 per acre. A plot of 13 acres had been immediately sold for £13,000, or double the cost price. He recommended that the company should sell some at reserve prices, a portion of which could be used in reducing the mortgage. It appeared also that two railway companies would want to acquire part of the land.

The auditors' report was read. It placed the liabilities at between £7,000 and £8,000, including an amount of £585 from a possible liability for income tax, which they considered was not due to the commissioners (laughter).

The SECRETARY stated that this was reserved to provide for any eventual claim, but was not paid.

The CHAIRMAN (Mr. Atkinson) said he need only remind the shareholders, in regard to the second paragraph of the committee's report, "We find that the promoters took the lion's share of the money paid for the purchase of patents, &c.," that none of the present directors of the company were promoters. As to the third paragraph dealing with the payment of the dividend, he could only say that it was easy to be wise after the event. The dividend was passed almost unanimously, Mr. Hurst being the only dissentient, and the shareholders then appeared very glad to receive it (laughter). Had the directors at that time had any idea that there was any fear of mechanical difficulties arising, difficulties which could not then be foreseen or anticipated, they would not have paid the money. It was then thought that there would be no difficulty in earning another 50 per cent. dividend in the twelve months following, and the directors, who were by far the largest shareholders in the company, had more cause than anybody to regret that this was not done. The board was advised at the time by its technical experts and accountants, and no one objected at the meeting. As to the amount paid by the Copper Company for the Wire Company's shares on the market being set in the balance-sheet as a good asset, he would read a letter from Messrs. Price and Waterhouse:—"We have examined the above account with the books and vouchers of the company, and find the same correct, subject to provision for any depreciation which may have arisen in the value of the patents (to the account of which the laboratory expenses and salaries have been carried), and in value of the investment in the shares of Elmore's Wire Manufacturing Company, Limited."

A SHAREHOLDER: Who suggested that purchase?

The CHAIRMAN: The stockbrokers of the company. ("Oh" and laughter.) The sum of £9,128 set down as paid to directors was spread over 3¼ years, and divided among eight directors, so that it worked out to an exceedingly small sum—only some £200 a year each—and each had had a very hard time of it, giving many hours daily to the affairs of the company. He might also remind them that during the time the company had been in a financial strait the directors had served without remuneration in any form. Turning to the land purchase, the chairman continued that the Copper Company originally made the purchase after a careful search had been made in different parts of the country for a site, consideration being had as to the price of coal in the locality and facilities for land and water carriage. All those facilities were combined in the Leeds site, and it was within a half-mile radius of most important collieries to which the company had constructed sidings. The largest item in their manufacturing was coal, so that the importance of getting it cheaply would be seen. One of the highest authorities on the subject of land

for manufacturing works was consulted, and the works were centrally situated between Goole, on the east coast, and Liverpool on the west, with water carriage at their doors. The former owner of the land was perfectly aware of its advantages for the purpose, and asked the Wire Company no less than £2,000 an acre for a further piece. Mr. Elmore only got the land after considerable difficulty and lengthy negotiation, and the company took it over at the exact price which he paid for it.

Mr. ELMORE remarked that, as a matter of fact, he made a small loss through the transaction.

The CHAIRMAN continued that its proximity to the Aire and Calder navigation enhanced its value.

A SHAREHOLDER: Not on 1½ tons a week.

The CHAIRMAN: But if you can make a profit on 1½ tons, how much could you make on 200 or 300 tons? At present we buy our coal at the works at the pit mouth price, delivered free. It was, he continued, in view of the increased value of the land by the expenditure on it, for the giving the Wire Company rights of way and use of sidings, that that company was charged £1,000 an acre. He could assure them that Mr. Gore's opinion as to the Wire Company having more land than was actually necessary, was not shared by practical works managers, who would not think of crowding the buildings for such a manufacture where slag would accumulate, and where spare land was required. The estate was magnificently situated, with extensive frontages to the Pontefract main road—in fact, was almost entirely surrounded by frontages. Portions of it could be sold, but he was sure it would be seen, in view of the future requirements and developments of the business, by the granting of licenses, by the applications of the process for purposes outside tube making and the manufacture of sheet, how very valuable the estate would be to the parent company. It would be gratifying to them to learn that the Copper Company's present liabilities were covered by the present stock of manufactured and raw copper, and customers' book debts. The company also had been actually making a profit, after the payment of works charges, since the date of the June report. Its output had been so exceedingly small, owing to the want of the raw material, and he quite agreed with the committee that when the works were working up to their full capacity, the cost of production would be greatly reduced. That was, in fact, the whole point of the business, there being a certain fixed output, below which they could not go, and every ton of output over which reduced the cost and tended to profit. The fact remained that an actual profit was made on the output of 1½ tons a week, and this alone ought to show the great value of the company's process. They must not allow themselves to be led away by pessimistic notions that because difficulties had arisen in the establishment of a brand new industry, the business was other than an absolutely sound and very profitable one. Orders were being received daily that had to be refused, because the company had not the raw copper, although they showed splendid profits. It gave the board great pleasure to acknowledge the committee's remarks in reference to the services of Mr. F. Elmore and Mr. S. Elmore, who, with Mr. William Elmore, had made every possible personal sacrifice to bring the business to a successful issue. It was equally gratifying to the directors to know, as they did, that their efforts had at last been crowned with success. In regard to the future, the chairman continued, that the board agreed with the committee that £17,000 additional capital would be sufficient, and that that would enable them to stock £10,000 of raw copper—sufficient to enable the filling of the tanks and the turning out of 20 tons a week without delay. They therefore adopted the suggestion of the committee, and proposed to issue the remainder of the shares, viz., 8,800 ordinary as preference. It was important to them to have the money immediately, and he ventured to think that there would be no difficulty in placing them at once. In fact he should be surprised not to see them placed in the room. Mr. Elmore had already practically placed 3,000 out of the 8,000 among his friends, subject to the resolution being passed to-day The chairman concluded by saying that now that the commercial working of the process had been established, future success was assured, and, with the raw material to enable them to execute their orders, without doubt a bright and prosperous career was ahead of them. He moved "That the 8,800 unissued ordinary shares of the company be issued, and be called preference shares, entitling the holders thereof to a cumulative preference dividend of 10 per cent. per annum, the said preference shares to have preference, not only as to dividend, but as to capital in the final distribution of assets."

This was seconded by Mr. TODHUNTER, and carried without dissent.

Mr. ELMORE then moved: "That the committee of the shareholders of this company, consisting of Messrs. Todhunter, Pritchard, Squire, and Owen Jones, be continued as a consultative committee to co-operate with the present board in making an issue of the new capital required, with power to accept the resignations of all or any of the present directors, and in conjunction with the present directors, to nominate new directors, and generally to advise the board, and report to a future meeting on the 28th inst."

A SHAREHOLDER asked for information as to the £11,938 expended in the market purchase of shares.

The SECRETARY said that the circumstances, as he remembered, were these: The brokers came in and said the shares were being banged down, and, unless the market was supported they would be further, and so a legitimate purchase was made of 3,000 shares. They appeared in the balance-sheet at cost price.

The SHAREHOLDER: Then, if I understand you correctly, you advanced this £11,000 to induce shareholders in the Wire Company to take shares, or not to withdraw their applications for them. Now, to this company it may be an advantage, but some of us who happen to be in the Wire Company don't happen to see it.

Mr. HAYS thought the presence of Mr. Squire would be a great advantage on the committee. If the capital were raised the company would go on as a purely commercial company, and have no regard to the prices of shares. In regard to the land, its value was shown by the care that was taken to ensure the security being ample for the mortgage. Do not let them part with their property too easily. He had authority for saying that portions of it could be sold at from £800 to £1,000 per acre, there being a great demand in the locality for land for small dwellings. The company was not being pressed by the mortgagees, and would not be. If the company wound up there would be plenty glad to snap up the property. He seconded the motion.

Mr. TODHUNTER suggested the subscriptions for the shares being paid to two or three trustees until the new board was appointed.

Mr. HAYS made a similar suggestion, the new board to be approved by a majority.

A SHAREHOLDER: Subscribe on certain conditions?

Mr. HAYS: Quite so.

The resolution was then carried unanimously.

Elmore's Wire Manufacturing Company, Limited.

REPORT TO THE SHAREHOLDERS BY THE SHAREHOLDERS' COMMITTEE.

As a committee appointed by the shareholders at the general meeting, held March 16th, 1893, we have examined the books and transactions of the company, and have inspected the works at Leeds, in company with Mr. Owen Jones, C.E., to advise us. We find that an excessive price was paid for the licenses, which, moreover, were accompanied by restrictions and royalty; that the land was charged to the company at double its cost price; that the works have been well built, but out of all proportion to the means of the company, and that capital has been expended both upon land, buildings, and plant, without any regard to prudent financial considerations. Consequently three-fourths of the buildings would be practically unused with an output of 35 tons per week. The engines and chimney are magnificent, but far beyond any probable requirements. We believe that there is no doubt at all about the efficacy of the process, or that the difficulties of manufacture have been overcome, and we think that there is a demand for the copper strip produced, at a highly remunerative price, if the production is on a large scale. The mandrels being uniform in size, there is great simplicity in the working once the routine arranged. This seems to us to accentuate the folly of erecting at the outset works of such enormous size, as there would have been no difficulty whatever in making additions. The accounts show liabilities, £21,963 7s. 10d., all of the most pressing kind. Expedients have been adopted, we hear, by the Messrs. Elmore to stave off proceedings, but it is evident that a settlement must be made, or the property will go out of the control of the company. The reasons which have led up to this condition of affairs are patent from the foregoing statements, and it remains to be considered whether money can be raised, not only to meet the liabilities, but to buy sufficient raw material. We find that a sum of not less than £50,000 would be required, and that the efforts of the directors have failed to bring an offer of more than £17,000 from those to whom they have applied for assistance, offering the security of the whole property, and these offers, in our opinion, were on ruinous terms. So it resolves itself into a question of the shareholders finding the money or the company being liquidated. We certainly believe that there is every prospect of success under prudent management, and if the shareholders decide on raising the money it would, in our opinion, be in their interest to have a small board of directors of men of business ability and experience, who would be likely to manage the finance of the company with prudence and economy. The inevitable alternative involves, we believe, the loss of the whole of the share capital subscribed, as under a forced sale, the land, works and machinery would not be likely to realise much more than enough to satisfy the creditors. There is, however, another possibility by the raising of a sufficient sum to pay off the liabilities and complete the plant—say £25,000 on debentures—and by the establishment of a Copper Supply Company, with a capital of, say, £25,000 paid up, to supply this company with copper, together with the cost per ton for manufacture into strip, the Supply Company taking the finished strip and sheet and selling it to customers, and handing over to this company the difference, after deducting their commission, the copper remaining the property of the Supply Company during the whole of the time. Obviously this would involve no risk to the Supply Company, and would furnish the Wire Company with raw material and working charges. We incline to advise the adoption of this latter proposal for the following reasons:—It necessitates only the raising of £25,000, instead of £50,000 by the shareholders, and provides good security (in the land, works and plant) for the amount of debentures to be subscribed even in the event of failure.

J. TODHUNTER.
A. PRITCHARD.
WM. R. BIDDELL.
JOHN WEBSTER.
S. W. GORE.

64, Cannon Street, London, E.C.
March 29th, 1893.

The accounts of the company, verified by an independent accountant, will be presented at the meeting on April 7th.

At the meeting of the company,

Mr. TODHUNTER read the report of the shareholders' committee. He understood that the directors gave up their claim to fees since the last general meeting. The bankers were not unfriendly, and would allow their claims to remain in abeyance as long as the property was protected. It must be remembered that if this company were wound up the license reverted to the parent company. It would, therefore, be very suicidal to sacrifice the money that had been laid out. In subscribing the £25,000, the shareholders would

not run any serious risk, because at a knock-down price the works would realise that amount. There could be very little doubt about that. Even if the supply company were not formed (as suggested in the report), he was informed there were people who would supply the Wire Company if it were free from liabilities. Apart from that, it might be wise to shut up the works until the parent company had shown its ability to work at a profit, which the committee believed it would be able to do if the small amount of capital asked for were provided. There would then be no difficulty in getting the capital required to work the Wire Company's works.

The CHAIRMAN proposed the same resolution in regard to a consultative committee as in the case of the Copper Company.

Mr. J. W. DALE seconded.

Mr. F. J. PILCHER, a consulting engineer, thought there was a great future before the process. The whole fault had been in commencing on too large a scale.

A suggestion was made that Mr. J. W. Dale's name should be added to the committee. This was approved and the resolution, with the addition, carried unanimously.

A SHAREHOLDER asked if there was any chance of the two companies being amalgamated.

The CHAIRMAN hoped they would be, eventually.

General FIFE moved and Mr. DIXON seconded the following resolution:—"That a vote of thanks be given to the committee for the time they bestowed on the affairs of the company, and that this general meeting of shareholders of Elmore's Wire Manufacturing Company adopt the report of the committee of the shareholders, dated March 29th last, and unanimously recommend the shareholders of the company in view of the evident commercial success of the Elmore process, to promptly subscribe the new capital required, on such terms as the committee now recommend."

This was carried, and the usual votes of thanks terminated the proceedings.

Woodhouse and Rawson United, Limited.

A MEETING of the debenture-holders and creditors of Woodhouse and Rawson United, Limited, convened by the trustees, was held on Monday at the Cannon Street Hotel, Sir Rawson Rawson presiding, "with a view to their considering the present position and their course of action in the future."

The CHAIRMAN observed that Mr. Pope and he, as trustees for the debenture stockholders of the company, had felt it their duty to call their clients together and invite all gentlemen interested in the company to meet them, to consider the position and to take such action as would secure for all the interested parties as large an amount of return as could be derived from the assets, and prevent those assets being dissipated either by interested or by hostile parties. The circumstances were stated in the circular which had been issued to the debenture-holders. A few weeks ago a receiver was appointed upon the application of a gentleman largely interested in the company, who certainly bore no ill-will to the company, and who took action in his own interest, and with no desire to injure anybody else concerned in the company. Since then a general meeting had been held, at which it was decided to voluntarily wind up the company, and the directors were convinced that even on the unfavourable figures of the gentlemen who were appointed to investigate the company's affairs, that that was the best process by which the interests of all could be protected. However, it appeared that petitions had since been presented against the company—to wind it up compulsorily. One had been presented by a debenture-holder for the amount of £250, and the other by a creditor for £185. The motions would be before the Court on Tuesday, April 11th, and the object of the present meeting was to get an expression of opinion from the creditors as to whether they would consider it in their interest to liquidate voluntarily, as arranged, or be forced into compulsory liquidation. The voluntary winding-up would be under the supervision of the Court. They should all understand what would be the general consequence of a compulsory liquidation. The assets of the company would be thrown on the market whether there was any demand for them or not, the object of the official liquidator being to wind up the affairs as speedily as possible, without much reference to what might be obtained by a little time and patience. The assets of this company were especially liable to depreciation by a compulsory liquidation, because they were not articles of general demand, and no time could be more unfavourable than the present for bringing upon the market electrical apparatus, electrical stock, and electrical plant, or the goodwill, the trading business of the company. There was every reason to believe that in a short time an improvement would arise. The trustees believe that under some such arrangement as that suggested at the last meeting the assets of the company might be secured in the best way, and the trustees now asked the creditors to pass a resolution in favour of voluntary, as opposed to compulsory, winding-up.

Mr. SAMUEL POPE, Q.C., said a receiver having been appointed by the Court on behalf of the debenture stockholders, the actual responsibility of Sir Rawson Rawson and himself as trustees, ceased, but in the sense of being responsible for what was done up to that time they had thought it their duty not to shirk responsibilty by shifting it on to someone else, but to call this meeting in their capacity as trustees. They would not now discuss the interests of shareholders. He had a very strong opinion as to what was best to be done in their interests, but was quite sure that in the interest of the debenture and debenture stockholders the only thing to be done was to secure the best possible realisation of the assets, so as to prevent any loss falling on those holders. The assets which formed the security were those connected with the industrial enterprise, which unfortunately had not been so successful as some of them hoped originally it would turn out, and consisted also of assets, the result of transactions the company had entered into. It must be obvious that to place assets of that peculiar character on the market, and sell them at break-up prices, would be disastrous. He thought even the interest of the debenture stockholders would be imperilled. One knew perfectly well that angry shareholders often desired a compulsory liquidation, because, not having any very great interest in the concern individually, they desired to put those who were responsible for the management of the business under what one of the financial papers very happily called "the harrow of the Official Receiver." But that was not the interest of the debenture holders. It might be that shareholders would think it right to put him under the official harrow. He must stand the racket of it if they did; but, at any rate, the debenture holders had nothing to complain of in him. They could not say he had not done his best to protect their interests, at all events. The applications for a compulsory winding-up were not by persons who had a large personal interest in the decision. They were not people who would be largely affected by a sacrifice of the assets; but they were represented by professional gentlemen, and he did no one an injustice if he said the sniff of costs was a great inducement to those gentlemen in regard to taking a particular course. What he wished was to present to the Court the views of those who, after all, were chiefly interested in the realisation of the assets under the best conditions. Let him point out that the committee, taking the worst possible view of everything, reported that in their judgment the assets of the company, if realised intelligently, would be sufficient to meet the liabilities of the company. Would they secure an intelligent realisation by forcing the assets on the market through an official receiver? He contended that they would not, but that they would do so by creating a channel through which those assets might be gradually realised. The industrial business, even now, when it was being carried on by a receiver, gave symptoms of vitality which were very encouraging, and according to figures prepared by the manager, were capable of producing £10,000 to £14,000 a year. Surely it would be a pity to sacrifice that. By the scheme of reconstruction it was proposed to create a new enterprise by means of capital which would not be chargeable with the old liabilities, thus enabling the new company to avail itself of the profits made. The debenture holders and stockholders would retain their security as at present; the unsecured creditors would, of course, come after them, so that it was to their interest that the assets should be intelligently and profitably realised.

A circular had been issued, by which it seemed the directors were to have trouble. He had done all he could to assist the share and debenture-holders since difficulties had arisen, but it must not be supposed that he was going to be charged, with the other directors, with issuing a fraudulent prospectus without resisting to his last moment, and to his last halfpenny, such an imputation. Some of them had probably received a circular asking them for subscriptions for securing combined action, and reference had been made to a "test case," but he warned them that there could be no combined action, and every case must stand on its own merits; and, speaking for himself, he would fight every case to the last, for no one should say he had ever done a fraudulent thing in his life. Therefore there could be no test action, and subscribers, although they might assist a particular individual possibly to get his money, would not get a penny of it themselves. Beyond that, he was not sure they would not make themselves liable for the costs of the other side if he did not succeed in his action.

Mr. DODSON moved, "That in the opinion of this meeting it is unadvisable that the company should go into compulsory liquidation, but that Mr. A. Youngs (of Turquand, Youngs & Co.) be retained as voluntary liquidator under the supervision of the Court, with a view to carrying out a scheme of reconstruction."

Mr. ACKWORTH seconded the motion.

Mr. STUTCHBURY gave an account of the industrial work at present being carried on, and expressed a strong opinion that the company could be made a success under good management.

Mr. POPE said the scheme provided that the selection of the management for the new company should be in the hands of those who found the money for the reconstruction.

Mr. LESLIE (the receiver) also expressed the opinion that, under proper management, the company had the nucleus of a very good business. He did not think even the debenture-holders would get 10s. in the £ if the assets were forced on the market.

Mr. MADDISON (solicitor to the receiver) said there was no fear of the business stopping for want of funds, unless a compulsory order were made, arrangements having been made for the use of £10,000 if it were needed.

Mr. HOLT, in the course of some very severe remarks, gave it as his opinion that the company had been as grossly mismanaged as the Balfour group, or any other company which had come to grief.

Mr. POPE remarked that that was a strong thing to say, considering that there was not an individual who had made a penny out of it.

The CHAIRMAN said he was present as a trustee on that occasion, and did not feel that he could reply to any remarks as to his conduct as a director.

Mr. MADDISON remarked that whatever rights the shareholders might possess, they would not be in any way prejudiced by the resolution proposed.

After further discussion the motion was put and carried, with only two dissentient votes.

The Telephone Company of Egypt, Limited.

THE directors' report for the year ended December 31st, 1892, presented at the tenth ordinary general meeting of the company, held at the offices, 14, Austin Friars, E.C., on Tuesday, the 11th inst., reads as follows:—

"The directors beg to submit herewith to the shareholders a balance-sheet and profit and loss account for the year ended December

31st last. The revenue account shows a balance to credit of £4,079 3s. 4d., after providing for interest on debentures, and including the amount of £1,414 17s. brought forward from 1891, there is a balance for disposal of £5,494 0s. 4d. This the directors propose to deal with as follows:—To pay a dividend of 6 per cent. on the preferred shares, free of income tax; to appropriate £426 7s. 4d. in reduction of capital expenditure and depreciation of stores, and to carry forward £1,446 7s. The directors regret to report serious irregularities on the part of the late agent at Cairo, who had been in the employment of the company for about 10 years. The losses consequently sustained, being in the opinion of the directors irrecoverable, they decided to deal with the matter at once by writing them off; but for these losses, the result of the year's working would have been more favourable. The head office of the company in Egypt has since been removed from Alexandria to Cairo, with Mr. Evans in charge, and it is hoped that the other arrangements which have lately been carried out in connection with the management and control of the business will lead to increased prosperity. The gross revenue of the company on January 1st last was £12,225, and the total number of lines, exchange and private, 1,138. The increase of business for the first quarter of the current year has been fairly satisfactory. Under the articles of association, Mr. Thomas Lloyd retires from the direction, but, being eligible, offers himself for re-election. Messrs. Price, Waterhouse & Co., the auditors of the company, also retire, and offer themselves for re-election.

At the meeting held on Tuesday, General Alexander Fraser, C.B., R.E., presided.

The SECRETARY (Mr. Chalmers), having read the notice convening the meeting,

The CHAIRMAN said he had not much to tell them beyond what was in the report. There was no need to go into detail regarding the irregularities of the late representative of the company at Cairo; Mr. Begni disappeared from Egypt, and the directors were consequently prevented taking any criminal proceedings against him, and thus they felt bound to write off the loss. The secretary, in consequence of these matters, went to Egypt to inquire into matters, and with the consent of the chief shareholders he was employed there about a month, with the satisfactory result that, through his report, the board had been able to put the management on what they hoped would be a safer basis, by the introduction of new blood, by placing there Mr. Evans, their general manager at Cairo. There was really more promise in respect of extensions of business at Cairo than even at Alexandria. Mr. Chalmers also had introduced certain safeguards with regard to local control of the business, and had suggested certain improvements in the construction of the works at Cairo. On the whole, the board thought that the result of his deputation to Egypt had been entirely satisfactory, as the board had been brought more in touch with the *employés* there. He then moved the adoption of the report and accounts, and the declaration of 6 per cent. dividend, free of income tax, on the preferred shares.

Mr. THOMAS LLOYD seconded, and it was unanimously carried.

The retiring director (Mr. Lloyd) and the auditors (Messrs. Price, Waterhouse & Co.) having been re-elected, a vote of thanks was accorded to the chairman, and the meeting closed.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.

THE directors' report for the half-year ended December 31st, 1892, to be submitted to the 39th ordinary general meeting on April 19th, 1893, reads as follows:—

"The usual statements of account for the half-year ended December 31st, 1892, are submitted herewith. The gross receipts, including government subsidies, have amounted during the half-year to £247,766 19s. 1d., against £243,658 8s. 10d. for the corresponding period of 1891. The working and other expenses, including £38,103 1s. 1d. for cost of repairs to cables and expenses of ships, absorb £91,768 18s. against £74,314 9s. 5d. for the corresponding period of 1891, leaving a balance of £155,998 1s. 1d. From this is deducted £6,030 8s. 3d. for income tax, and £31,895 for interest on debentures, debenture stock, and contribution to sinking fund, leaving as the net profit for the half-year £118,072 12s. 10d., which, with £70,271 1s. 9d. brought forward from the previous half-year, shows an available balance of £188,343 14s. 7d. One quarterly interim dividend of 1¼ per cent. has been paid for the half-year, and it is now proposed to distribute another of like amount on the 20th inst., making, with the interim dividends paid for the first half-year, a total dividend of 5 per cent. It is also proposed to pay a bonus of 4s. per share, or 2 per cent. making a total distribution of 7 per cent. for the year 1892. The balance of £75,843 14s. 7d. has been carried to the general reserve fund, which, after being credited with interest received on investments, now stands at £509,732 19s. The alterations of tariff with the Australasian Colonies, to which reference was made in the last report, came into force on January 1st last, and the result so far is encouraging. Since the close of the half-year, the tariffs at the stations affected by the serious depreciation in the silver currency have also been adjusted, so as to avert, as far as possible, the loss on exchange from which the Company has so long suffered, and which during the past six months amounted to the large sum of £11,692. In accordance with the provisions of the trust deed, dated May 15th, 1879, 353 of the company's 5 per cent. Australian Government subsidy debentures, amounting to £35,300, were drawn by lot on the 6th inst. for payment at par on July 1st next. The company's maintenance ships have as usual been employed on various repairs during the half-year under review, but, owing to most of the cables being duplicated, the traffic has not been materially affected. In accordance with the articles of association, Sir John Pender, G.C.M.G., M.P., and Sir James Anderson retire by rotation, and, being eligible, offer themselves for re-election. The retiring auditors, Mr. Henry Dever and Messrs. Welton, Jones & Co., also offer themselves for re-election.

Eastbourne Electric Light Company, Limited.

THE Mayor of Eastbourne (Alderman Boulton, J.P.), who is chairman of the company, presided at the annual meeting last week, and, in moving the adoption of the report, which recommended a dividend of 3 per cent., said he did not think there could be any doubt now as to the success of the company. The lamps actually fixed numbered 7,667, and they had on order 353. They had a total of 10½ miles of circuit. The shareholders had waited 12 years for a dividend, and the directors thanked them for waiting so patiently.

Mr. J. S. LINGHAM, in seconding, said the new houses wired since Michaelmas last scarcely contributed to the dividend, but were now producing money, and he believed he was correct in saying that, notwithstanding the reduction in price from 10d. to 9d. per unit, which was equal to 10 per cent., their income for the past quarter would exceed that of the corresponding period last year.

The resolution was carried, the chairman re-elected, Messrs. Hart Bros., Tibbetts and Co. were re-elected directors, and the directors voted £100 for their services during the past year.

The Johannesburg Lighting Company, Limited.

THE second ordinary general meeting of this company was held yesterday week at Winchester House, Old Broad Street, under the presidency of Mr. Wm. Garland Soper (chairman).

The notice convening the assembly having been read by the SECRETARY,

The CHAIRMAN, in moving the adoption of the report and accounts, mentioned that it would have been more happy if there had been a profit. The directors considered that the assets were entered lower than their value. The consumption of gas showed a marked progress, but the production of gas would soon be cheaper than either electricity or gasoline. As regarded the supply of electricity, the demand for this light was in excess of the quantity which they could supply. The company had become unequal to meet the present increasing demands for light which were arising both for gas and electricity. It was therefore necessary that additional capital should be provided to meet the requirements. He then moved the adoption of the report and accounts.

This proposal was seconded, and was carried, as was also a resolution for increasing the debenture capital by £40,000, to enable the company to cope with the increasing consumption of both illuminants.

The proceedings terminated by the re-election of the retiring director and auditors.

The Indo-European Telegraph Company, Limited.—The directors of the Indo-European Telegraph Company, after adding £10,000 to the reserve fund, have determined, subject to audit, to recommend the payment of a dividend for the six months ended December 31st, 1892, of 17s. 6d. per share, making with the interim dividend already paid 6 per cent. per year, and a bonus of £1 per share, both free of income tax, making in all 10 per cent. for the year. The dividend and bonus will be payable on and after May 1st next.

Hobart Tramways Company.—An extraordinary general meeting of this company was held yesterday week at the offices, College Hill Chambers, E.C., under the presidency of Mr. Alfred Mattei, LL.D., to consider a resolution altering the name of the company to the Hobart Electrical Tramways Company. A resolution in accordance with the object of the meeting was agreed to, and a vote of thanks to the chairman closed the proceedings.

Submarine Cables Trust.—A payment of £1 10s. will be made on account of the coupon due on April 15th, on and after that date by Messrs. Glyn, Mills & Co.

National Telephone Company.—The Right Hon. Lord Balfour of Burleigh has joined the board of this company, and will assume the position of Vice-President of the company.

Stock Exchange Announcements.—The Stock Exchange Committee have ordered the following to be quoted in the official list:—National Telephone Company, Limited. Further issue of 4,120 ordinary shares, Nos. 454,758 to 458,867.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending April 9th, 1893, amounted to £842; week ending April 10th, 1892, £742; increase £100; total receipts for half-year, 1893, £12,856; corresponding period, 1892, £11,761; increase £1,095.

The Western and Brasilian Telegraph Company, Limited. The receipts for t week ending April 7th, after deducting 17 per cent. of the gro receip'ɔ payable to the London Platino-Brasilian Telegraph Compan Limited, were £2,692.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation, April 6th.	Closing Quotation April 13th.	Business done during week ended April 13th, 1893. Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	101 — 104	101 —104	102	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	52½— 53½	52½— 53½	53	...
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	93 — 94	92 — 93 xd	94	92⅝
2,876,140*l*	Do. do. Deferred	Stock	12⅝ — 13¼	12⅝ — 13¼	13	...
130,000	Brazilian Submarine Telegraph, Limited	10	11½ — 12 xd	11½ — 12	12	11⅝
36,400*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	100⅜	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	105 —109	105 —109	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3 — 3½	3 — 3½	...	...
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2½ — 2⅝	2⅛ — 2⅜	2⅜	2 3/16
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	103 —105	105 —107	105½	104¼
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
630,000*l*	City and South London Railway	Stock	37 — 39	37 — 39	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	11½ — 12	12 — 12½	12¼	11¼
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	10 — 10½	10¼ — 10⅝	10 11/16	10⅜
$7,716,000	Commercial Cable, Capital Stock	$100	178 — 182	165 —170	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	¼ — ⅜	¼ — ⅜	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5¼ — 5⅝	5¼ — 5⅝	...	...
16,000	Cuba Telegraph, Limited	10	11½ — 12½	11½ — 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18 — 19	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ — 3¼xd	2½ — 3¼	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10 xd	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅝ — 11⅞xd	11⅝ — 11⅞	11⅞	11 11/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅜ — 15½	15 — 15½xd	15½	14⅜
70,000	Do. 6 p. c. Preference	10	16½ — 16⅝	16½ — 16⅝xd	16⅝	16½
175,900*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,294,100*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	114 —117	114 —117	115⅛	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅝ — 15⅝	15½ — 15⅝	15 13/16	15⅝
70,600*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	103 —106	103 —106	105½	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	103 —106	103½	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	112 —115	112 —115	114½	...
108,700*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	102 —105	102 —105	...	...
146,800*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	...	...
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	2½ — 3	2½ — 3	2⅝	2 11/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/16 — 3/16	1/16 — 1/8	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3/16 — 1/8	1/8 — 1/8	1/16	1/32
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1/32 — 1/16	1/32 — 1/16	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1½ — 2½	1 — 2	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜ — 10⅛	9⅝ — 10 xd	10⅛	9⅜
180,042	Do. do. 6 p. c. Preference	10	15⅜ — 15⅝	15½ — 15½xd	15⅝	15⅜
150,000	Great Northern Tel. Company of Copenhagen	10	19¼ — 19⅜	19½ — 19⅝	19⅜	19½
200,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	106⅝	106
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ — 5½	4½ — 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6½ — 7½	6½ — 7½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	22½ — 23⅛	22 — 23	22⅜	22½
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	44 — 46	43 — 46	45½	42
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½ — 3½	2½ — 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4⅛ — 4⅜	4⅛ — 4⅜	4¼	4 1/16
10,000	Do. do. fully paid	5	5 1/16 — 5 3/16	5⅛ — 6¼	5⅞	...
38,348	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½ — 7	7⅛ — 7⅜	7⅜	7
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	...	...
454,747	National Telephone, Limited, Nos. 1. to 438,984	5	5⅛ — 5⅛	5⅛ — 5⅛	5⅛	5 5/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	15 — 15½	15 — 15½	15 7/16	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	14¼ — 14½	14¼ — 14⅜	14 11/16	14⅜
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5 5/16
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —116	113 —116	115	114
48,860*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,451	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5½ — 6½	5½ — 6½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	¼ — ½	¼ — ½	...	...
11,802	Reuter's Limited	8	7 — 8	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8 — 8½	7¾ — 8½	8⅛	7 3/16
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8⅛	8
3,381	Submarine Cables Trust	Cert.	118 —123	120 —125	121½	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3 — 3½	3 — 3½	3⅛	3
37,350	Telegraph Construction and Maintenance, Limited	12	33 — 36	32 — 35	34⅜	33¼
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2½ — 3	2½ — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 — 100	90 —100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½ — 7½	5½ — 6½	5½	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	...	...
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	105 —109	105 —109	...	...
64,242	Western and Brazilian Telegraph, Limited	15	7⅜ — 8½	7⅜ — 8½	8½	7 13/16
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5¾ — 6¼	5¾ — 6¼	6 1/16	5 15/16
33,129	Do. do. do. 5 p. c. Deferred	7½	2 — 2½	1¾ — 2¼	1 15/16	...
178,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	105 —108	106 —109	...	...
222,700*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	105 —108	106 —109	...	...
88,321	West India and Panama Telegraph, Limited	10	1½ — 1⅝	1⅝ — 1¾	1¾	1⅝
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11½ — 11⅝	11½ — 12	11¾	11⅝
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	9½ — 10½	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	108 —111	108 —111	...	...
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
169,000*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —104	101 —104	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½ — 6	5½ — 6	...	...

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5, (fully paid 5½—6.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100—103.—Electric and General Investment, shares of £5 (£1 paid), 1¼—2¼.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5, 5—5¼.—House to House Company (£5 paid) 1½—2½.—Do. 7 per cent. Preference of £5, 5—5¼.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅞—6⅛ xd, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6—6½ xd.—Liverpool Electric Supply Shares of £5 (fully paid), 5⅛—5⅛ xd.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating, 6 per cent. £100 Debentures, 101—103.

Bank rate of discount, 3½ per cent. (January 26th, 1893).

REVIEWS.

Medical Electricity. By W. E. Steavenson, M.D., and H. Lewis Jones, M.A., M.D. (H. K. Lewis.)

Any work from the pen of the principal author of this book, the late Dr. W. E. Steavenson, cannot fail to command the respect of all who take any interest in electro-therapeutics, and it is matter for regret that he did not live to complete it. Dr. Steavenson's position as physician in charge of the electrical department at St. Bartholomew's (we believe the oldest hospital electrical department in the country) for several years, gave him exceptional advantages in the way of experience, while the thoroughness of his methods, and the cautious character of his advances, earned for him a high reputation among his professional brethren, a reputation justly higher than that which has fallen to the share of some who, though they may perhaps have been more brilliant, have also been less cautious. Unfortunately it is rare for electricians, as such, to feel respect for the electrical knowledge of electro-medical specialists, even when their *bona fides* is beyond question; but Dr. Steavenson was held in honour by electricians and medical men alike. The book under consideration is worthy of its designer, and is clearly a valuable contribution to the literature of electro-therapeutics.

In paying this tribute to the late Dr. Steavenson, we do not forget the share in the work undertaken by Dr. Lewis Jones, upon whom Dr. Steavenson's mantle has fallen at St. Bartholomew's. He has performed the difficult task of editing and elaborating Dr. Steavenson's manuscripts with considerable success, and has added, up to date, matter for the most part breathing the same thorough and cautious spirit.

The book is eminently practical and comprehensive, dealing, as it does, with the history of the subject from the time of Gilbert onwards, and leading up to the latest methods of electrical treatment.

Two excellent chapters are devoted to the general physics bearing upon the subject, and are acknowledged in the preface as being mainly due to the pen of Mr. H. M. Elder. Excellent as they are, the wisdom of their presence is open to doubt. We have long endeavoured to show in this Journal that a proper study of the physics common to all branches of applied electricity is a *sine qua non* to medical electricians, and now that the time has at length arrived when the medical profession and their technical organs are beginning to recognise the truth of our contention, it may not be unfitting that authors of books on medical electricity should consider how far the desired end can be obtained by crowding into their text-books a few chapters upon physics, however well they may be written. The electrical engineer, whatever branch of applied electricity he intends to adopt, has to first prepare himself by a careful study of complete text-books, often of no mean size, dealing with the physics which form a common basis to all branches; and surely it is necessary for the electro-therapist to prepare himself in like manner. Medical men, when writing a treatise on forms of treatment by drugs, do not offer their readers instruction upon chemistry by attempting to include it in their book. They write on the understanding that the student has already been through a course of study in the general principles of chemistry, so far, at least, as they are likely to apply to medicine. Why, then, should writers on treatment by electricity add to the difficulties of themselves and their readers by endeavouring to condense the general principles of electrical phenomena into the small space which is all the exigencies of circumstances leave available in the one book. It seems to us that this effort at comprehensiveness involves the saying of either too little, or, in another sense, too much. In the volume before us the latter error has resulted, for it is impossible for the reader to understand some of the calculations and formulæ given when relying upon the very condensed instructions which lead up to them. For instance, after only three pages dealing with electro-magnetic induction, we come to a short section on self-induction, in which appears the following equation, "$Q = \int_0^\tau C\,dt - \frac{n\,L'\,C}{R}$ and $Q_s = \frac{n\,M'\,C\,p}{R}$ when τ stands for the whole time of variation of the current, and therefore Q is the total number of units of electricity that have passed, measured in coulombs, if the current is expressed in ampères." It is true that the reader is referred to other works on electricity and magnetism for further information, but if that be necessary, it is clear that the information contained in the book itself is not sufficient, even while, as we have shown above, it is in one sense too much. We venture to think that, though in this book the instruction in physics is exceptionally good for this class of work, yet the "student and the practitioner" would have been better served by a few short sentences recommending a preliminary study of one or two of the standard text books on electricity and magnetism, with hints as to the need for special attention to points more directly bearing upon the problems and practical difficulties the electro-therapist has to face. The various forms of battery are carefully described, and a very useful "Table of Batteries" is given on page 139. A short section is devoted to "use of electric lighting currents," wherein it is stated that "In the case of direct current distribution no doubt the best method of utilising the current so supplied is to charge accumulators with it." This may be true so far as small lamps, cautères, and other surgical instruments are concerned, but not for general treatment. The authors appear to have overlooked the fact that such currents may be used with perfect safety and much more economically by a method described in the *Lancet* in December, 1891 and April, 1892, by Dr. W. S. Hedley, and since embodied in the form of practical apparatus by Schall, and by the Electro-Medical Apparatus Company. Chapter VII. treats of electro-physiology, and a lengthy section of it is devoted to "the resistance of the body." In speaking of the electrical phenomena of nerve and muscle, the supposed existence of a current of rest is referred to, and it is very properly pointed out that "it is probable that this current of rest only exists in damaged tissue, and is not present in normal parts at all, but that it is set up by chemical changes resulting from the injury." In a section upon "Electricity in cases of suspended animation," practical instructions are given for the use of coil currents to assist artificial respiration in cases of apparent death from drowning. Chapter ix. concludes with a very necessary warning against self-treatment by patients, and the wearing of electric belts. Chapter x. is devoted to the electric bath, to the use of which the authors attach considerable value. The still open question of the proportion of the total current that passes through the patient when both electrodes are in the water is not discussed. The book states that "It has been calculated that an eighth part only of the current traverses the patient." "Thus with a current of 200 milliampères passing through the bath, the patient's body carries about 25 only." This on page 281, but on page 282 the following sentence appears: "The current to be employed in a galvanic bath must be very gradually raised until the galvanometer registers 200 milliampères, of which the patient really gets a current of about 40 milliampères." Which do the authors mean, 40 or 25? The slip is unfortunate, as the difference in the quantities named is considerable.

The terms galvanism, Faradism, and Franklinism are used freely, and disfigure the book in all directions, save and except in the chapters by Mr. Elder. The advantage of retaining these words is hard to see, especially as they find no place in the physics instruction given, while their misleading character renders them very objectionable to all true physicists.

The portions of the book occupied with particulars of a distinctly medical and surgical nature, of course we do not attempt to criticise. We find them distinctly readable, clear, and interesting, but note with regret that they do not include records of actual cases. As the authors had such exceptional opportunities for obtaining such records in their hospital department, they doubtless have not withheld them without good reason, but we should have expected that such records would prove not only interesting, but distinctly valuable, to the students and practitioners to whom the book is addressed.

Manual of Practical Medical Electricity. By Dawson Turner, B.A., M.D. Baillière, Tindall and Cox.

We have sometimes been led to wonder why in these modern times it should be apparently deemed necessary for every medical man who takes up the practice of electro-therapeutics to write a book on the subject. It is hard to see what good can be attained by the multiplication of books differing scarcely at all from one another, constructed on the same monotonous pattern, containing the same modicum of

condensed physics, illustrated by the same liberal array of the same makers' apparatus and instruments, and, alas! setting forth little or nothing that is new or likely to throw fresh light on one or other of the many unsolved electro-medical problems. Dr. Turner's book, though a good specimen of its kind, is not entirely free from the family traits just referred to. The general features, the condensed physics and the familar apparatus illustrations are all there, but in spite of this it has much to raise it above the ordinary level. In the chapter on electro-diagnosis some valuable original work is shown which is of considerable importance. We refer to the author's researches upon the resistance of urine and the special bearing such resistance has in the diagnosis of disease. Much care has been expended upon this investigation, and a number of interesting experiments are recorded, their results being tabulated in a clear and comprehensive manner. The author claims that by testing the resistance of urine tedious chemical analysis may be often avoided and information obtained as to the healthy or pathological condition of a patient. Dr. Turner names from 40 to 45 ohms as the specific resistance of healthy urine, and gives tabulated results of tested cases. In one (of Bright's disease) the specific resistance was found to be over 114 ohms, and after six months' treatment was brought down to 42·5 ohms. In another (of pernicious anæmia) a resistance of 68 ohms was found to increase to 115·6 as the patient got worse and to decrease again to 44·2 as he progressed towards recovery. The resistance of the body and its parts with the above exception is left much as it was before, though the author has been at some pains to collect some of the best opinions thereon. It is curious that in his endeavour to quote the latest information he should have omitted all reference to the difference in the resistance of the body to transverse as compared with longitudinal currents, some interesting particulars of which were brought before the British Association last August by Mr. Newman Lawrence. Doubtless to the medical man who carefully passes a definite current and maintains it by altering the E.M.F. or the total resistance in the circuit the finer variations of resistance are not of immediate consequence, but it is possible that a closer study of them may prove valuable as well as interesting in the near future. Among the apparatus described one novelty appears in the form of a cut-out and commutator devised by the author, by means of which the cells of a battery can be connected either in series or in parallel easily and quickly. His suggestion, however, that its use does away with the need for a rheostat in circuit with surgical lamps or cautères seems hardly justified, for as then only three or four cells are needed the comparatively large amount of E.M.F. brought into play by the addition of another cell would in many instances result in the destruction of the lamp or melt the cautère if uncontrolled by added resistance. The section on "Electricity of High Potential and Rapid Alternation" is rather disappointing. We are told that "various theories and hypotheses have been advanced to explain the immunity of the body from the effect" (we presume harmful effect is here meant) "of such currents," and some of these are given in brief, but no attempt is made to sift them or draw conclusions from them. Perhaps the time is not yet ripe for this.

As the terms galvanic electricity and Faradic electricity are used in the book, we cannot close this review without again pointing out how undesirable it is that they should still be adopted in medical works. Most physicists are agreed, and our present author seems of the same opinion, that electricity is one and the same however generated. The currents obtained may be either continuous, interrupted or alternating, and each of these forms of current possesses certain physiological properties whatever the source of generation be. For instance, the continuous current may be obtained from a galvanic battery, or from a well-commutated direct current dynamo, and the alternating from a coil, or an alternating current dynamo. In the one case the continuity endows the current with certain physiological powers, in the other the alternations endow it with certain other physiological powers. In neither has the source of generation any physical or physiological influence. Why, then, speak of galvanic or Faradic electricity as if it were something in itself different from electricity, *per se*. Such terms, especially in so complex a subject as medical electricity, act as a stumbling block to the student, and often in unprincipled hands become a trap to the unwary.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

An ordinary general meeting of this Institution was held on Thursday evening, March 23rd, Mr. W. H. Preece, F.R.S., President in the chair. The minutes of the last ordinary general meeting having been read and approved, and other general business transacted, Sir David Salomons read a paper on

A New Form of Portable Photometer.

If two nicol prisms be mounted in a tube and a source of light is observed through them, then the amount of light which will reach the eye is governed by a well-known law depending on the relative positions of the prisms to one another. The quantity of light passing depends upon a function of the angle which the polarising plane of the polarising prism makes with the polarising plane of the analyser. And since one-half of the light issuing from the source of illumination observed will never reach the eye (*i.e.*, the ordinary ray which is thrown out by the polariser), the light which reaches the eye will be half the original light multiplied by a function of the angle included between the polarising planes of the two nicols. This function is the square of the cosine of the angle included between the two planes mentioned. Consequently, the quantity of light reaching the eye from a given source will be governed by the well-known formula, as follows:—

Let I = intensity of the light observed,
" L = light which reaches the eye,
" O = ordinary ray in polariser,
" E = extraordinary ray in polariser,
" θ = angle between the planes of polarisation of polariser and analyser,

the light which reaches the analyser is E, or $\frac{I}{2}$, since $O = E$ and $I = O + E$.

The amount of light which reaches the eye is expressed by the equation,

$$L = \cos^2\theta\, E \text{ or } L = \tfrac{1}{2}\cos^2\theta\, I;$$

hence L varies as $\cos^2\theta$.

In this instrument two tubes are mounted as a binocular capable of being adjusted for distance apart, in order to suit the eyes of different individuals, and the hinge portion used for such adjustment is made without a stop, so that the position of the tubes may be reversed in its relation to the eyes. Each of these tubes contains two nicols, arranged as usual; but, instead of the analyser being revolved, the polariser is capable of being turned. The polarising plane of the analyser is set at 45° from the vertical in order to obtain the scales in a convenient position upon the tubes.

Consider for a moment one of the tubes—a description of which applies to the second. The polariser is so mounted that its position is indicated upon two scales at the same time; the one being graduated in degrees to be used for accurate work, and the other graduated in divisions indicating what proportion of the light observed will reach the eye. One scale is called the "degree scale," and the other the "light proportion scale." The latter scale is so graduated that it reads unity for the "light field," and zero for the "dark field." The intermediate division numbers are 0·1, 0·2, and so on. This scale is used for approximate measurement.

When the "light proportion scale" reads unity the "degree scale" indicates 0°, and when the former shows zero the latter scale reads 90°.

The method of determining the positions of the divisions:—

We have $$L = \tfrac{1}{2}\cos^2\theta\, I = \cos^2\theta\, \frac{I}{2}.$$

Now equate $\cos^2\theta = 0{\cdot}1$
$\cos^2\theta = 0{\cdot}2$, and so on.

Solve each equation, and the values of the angles so found are the successive points on the scale required. The following table gives the angles by working to three decimal places in making the calculation:—

Divisions upon the "light proportion scale."	θ	
0	90°	no light passes.
0·1	71° 26′	
0·2	63° 34′	
0·3	56° 13′	
0·4	50° 14′	
0·5	45°	
0·6	39° 46′	
0·7	33° 47′	
0·8	26° 26′	
0·9	18° 34′	
1·0	0°	maximum light passes.

If the values for $\cos^2\theta$ for the right hand and left hand tubes are A and A′, and the values of the lights observed with the right and left tubes are I and I′.

Since the photometer is balanced at the start, each eye receives the same amount of light, it is therefore correct to equate $L = A\frac{I}{2}$ and $L = A'\frac{I'}{2}$. It is evident the result will remain unaltered if we regard these equations as $L = A\,I$ and $L = A'\,I'$, and it will save the observer the trouble of doubling the final result.

In front of the polariser a small round opal, or some equivalent, screen is placed; and the light upon this screen is that which is directly to be observed. The screen is mounted in a cell and screwed on the end of a tube. A lens is inserted in the tube to focus this screen upon the retina. This screen may be removed. When desired,

an adjustable lens may be added in front of the observation tube to focus the light in the plane of the screen. In some cases this may be convenient.

To make an observation with this instrument it is placed before the eyes in the same way as a field glass, each polariser having been turned to the position of "light field," when the "degree scale" will indicate zero degrees, and the "light proportion scale" will read 1. One tube is now directed towards the source of light under examination, and the other tube towards some known standard radiant. The distance of the light under observation, and the distance of the radiant from their respective screens (which are before the polarisers) are measured. Then, according to the usual methods of photometric measurement, assuming that the source of light under observation cannot be moved, it would be necessary to shift the standard radiant in order to get a balance—*i.e.*, to render the screen, observed by each eye, illuminated at the same intensity. Instead of shifting the standard radiant, the balance with this instrument is obtained by revolving the polariser, which faces the brighter screen (should any difference exist) in order to reduce the illumination of both screens to the same apparent intensity. The value of the light under investigation in terms of the standard may be calculated when the amount of light cut off by the polariser, the distances of the two sources of illumination in question, and the value of the standard illuminant, are known.

It should be again observed that, since the ordinary ray reaches neither eye, it is equivalent to an equation, each side of which is divided by two: and, consequently, the final result will be the same as if no such division by two existed.

To make such an instrument thoroughly practical several mechanical appliances are needed, and exist in this instrument. It will be a convenience if the standard radiant can be placed always at such a distance that the square of this distance shall be unity; and, instead of this radiant being in front of the instrument—which would cause it to shed light on the other screen, or in the way—it should be placed at the side, and illuminate its screen by means of a right-angled reflecting prism, and the arrangement is such in this apparatus.

The comparison radiant for this instrument consists of a standard candle contained in a tube; the candle being fed up by means of a spring, the top of the tube forming an abutment to keep the candle flame at one level although the length of the candle is always altering. This abutment piece is surrounded by a cup to catch any grease which may run over. The candle tube has a slot cut in it, in order that the amount of candle in the tube may be observed at any moment. The candle tube is carried in a light framework, which supports a metal cylinder that acts as a chimney to keep off draughts. This chimney has in it a small window, into which slides a slip of clear glass, and it is through this window that the light from the candle passes to illuminate its screen. The clear glass may be replaced by tinted glass when desired.

The chimney is carried in a special form of gimbals, so that no matter what inclination may be given to the binocular, the candle will always remain vertical, since the gimbals are attached to the binocular by means of an arm. The inner ring of the gimbals is in reality only half a ring, and the plane of the outer ring when the candle is vertical, instead of being at right-angles to the axis of the candle, is oblique to its axis. This construction is necessary, otherwise the rings would come before the window in the chimney and so obstruct the light. In front of this window is placed a suitably shaped tube, capable of being lengthened and shortened, if required, and which fills up the space between this window and the reflecting prism; this prism being situated in front of the screen at the end of the tube containing the nicols. The object to be secured is that extraneous light should be kept from this screen. The weight of this adjusting tube is counterpoised so that the candle may always remain vertical. The arm connecting the candle with all its supplementary apparatus is carried upon its observation tube (which contains the nicols) by means of a ring arranged in such a way that, although removable, it cannot turn except to a small degree by means of an automatic motion. The reflecting prism also is carried in a similar way. The arm has two motions upon it—one a clamping joint to enable the candle flame to be brought in front of the prism to a nicety, and the other a kind of parallel motion arrangement by which the candle can be placed to two given distances from the prism, according as the parallel arrangement (somewhat similar to a parallel ruler) is pushed to the one side or to the other. The measurements and the arrangement of the details are all so adjusted that the candle flame will always be facing the reflecting prism for all inclinations of the binocular, and the two distances to which the candle may be moved are so regulated that the apparent distances of the flame from the screen it illuminates shall be either the square-root of 10 or the square-root of 12. These two distances are the most convenient, one for use when measuring by a decimal system, and the other when meaurements are made in feet.

It may be mentioned that the candle arrangement with its arm can be removed at pleasure, so also can the reflecting prism. It will be noticed that the weight of the candle with its apparatus tends to twist the ring round upon the tube containing the nicols, and it might appear that this could be avoided by simply cutting a slot in the ring to push over a pin screwed into the nicol-tube. This, however, is not feasible, for, in order always to have the relative positions of all parts as they should be, it is essential that the ring, which carries the candle and its arm, should have a slight circular motion. This is obtained by placing upon the direct observation nicol tube another ring, which is connected with the candle-arm ring by means of a slotted sliding bar, in such a way that the candle apparatus cannot be displaced, and the relative positions are always correctly maintained.

A description of this part, simple as it is, would be complex, so that references must be made to the plates, by the inspection of which the arrangement will appear clear. The eyes of any one person differ, so that an observation error is sure to be introduced. In order to eliminate this error, the instrument is so arranged that the relative positions of the parts of the instrument can be reversed when a second observation is taken, which is equivalent to an observation with the eyes reversed. A mean of the two observations is then taken. The instrument described has this particular advantage not possessed by other photometers.

At starting it is only necessary to place the candle in its fittings on any of the photometers in general use, in order to ascertain the standard value of the light which issues from the window and from the tube when the latter is used. These two values, which may practically be considered as constants, can be engraved upon the chimney. The loss of light due to the reflecting prism may be ascertained at the same time.

When it is desired to put the instrument (set up and the candle alight) upon a table, it is placed upon a small slender tripod. This tripod, which can be closed to render it portable, accompanies the instrument. It may often be found convenient, when using this apparatus, to place it upon a tripod after the same manner as a theodolite.

This photometer packs up into a sling case barely larger than those used for field glasses.

Some of the advantages derived from this instrument may be stated as follow:—Very powerful arc lights may easily be compared with one another or with a standard source of light. It may be used for measuring various sources of light, such as daylight out of doors with light in a room; and for the estimating of photographic exposures. That the instrument is exceedingly convenient, compact, portable, and easy to use, need scarcely be stated. It may also be employed for rapidly comparing the light in one or more places far apart, which is frequently a great convenience.

Two points alone might be urged against the principle. The first is that nicol prisms are not, as a rule, sufficiently accurate for very close measurements. However, to make these prisms quite accurate, or at any rate sufficiently so for this purpose, is no difficult matter, as may easily be proved by taking a number of nicol prisms at random and testing them. Secondly, errors are introduced due to internal reflections as well as reflections which take place at the surfaces of the prisms. These losses occur for the nicols in both tubes, and when the losses in each tube are deducted from one another for any positions of the nicols, the difference will be found to be so small as to affect to an inappreciable extent, the result.

The nicol prisms in the tubes might be dispensed with and be replaced by adjustable diaphragms somewhat similar to the "Iris" pattern, one being placed in each tube and an index scale showing the area, which is free, for the light to pass; as well as a proportion scale for reading the quantity of light which passes without calculation. The principle, of course, would remain the same as that already described.

Again, it might be possible to vary the proportion of light passing down the tubes by wedges of tinted glass; but on the whole the nicols appear to present so many advantages that a preference was given to their use.

Appended hereto are the formulæ applicable to this apparatus for general work, and it will be unnecessary to refer to any tables or to make tedious calculations, excepting in those cases where great accuracy is required, in which event the scale of degrees must be used and the values of the cosines be looked out and squared.

Let x = The light under examination.
" l = The comparison light expressed in standard candles.
" D = The distance in inches of x from the screen of the photometer facing x.
" d = The distance in inches of l from the screen of the photometer facing l.
" θ = The angle between the polarising planes of the nicols in the tube facing x.
" θ' = The angle between the polarising planes of the nicols in the tube facing l.

Then
$$\cos^2\theta \frac{x}{D^2} = \cos^2\theta' \frac{l}{d^2}$$

and
$$x = \frac{\cos^2\theta' D^2}{\cos^2\theta d^2} l$$

Let
$$\cos^2\theta = A \text{ and } \cos^2\theta' = A'$$

Then
$$x = \frac{A'}{A}\frac{D^2}{d^2} l$$

In this photometer d may be made $\sqrt{10}$ or $\sqrt{12}$, so that the last equation may be written,

$$x = \frac{A'}{A} \cdot \frac{D^2}{10} l \text{ or } \frac{A}{A} \cdot \frac{D^2}{12} l$$

according to the value of d.

If D is divided by 12 the distance will be expressed in feet.

Let
$$\frac{D}{12} = D'$$

Then
$$x = \frac{A}{A} \cdot \frac{D^2}{12} l \qquad (1)$$

when distances are given in inches,

and
$$x = \frac{A D'^2 l}{A} \qquad (2)$$

when distances are expressed in feet.

When the values of A and A' are calculated from the "degree scale," certain special cases occur which simplify the equations. They are when $\theta = 0°$, $\theta' = 0°$, $\theta = \theta' = 0°$, $\theta = 45°$, and when $\theta' = 45°$. In these cases A and A' will become unity for 0° and ½ for 45°.

With most observations the value of A′ will be 1, and equations (1) and (2) will then become,

$$x = \frac{D^2 l}{10 A} \quad (3)$$

and

$$x = \frac{D'^2 l}{A} \quad (4)$$

When the values of A and A′ are obtained from the "light proportion scale," the values are in decimals of one place, so that these figures may be read as whole numbers multiplied by 0·1.

Equations (3) and (4) may then be written—

$$x = \frac{D^2 l}{10 A \times 0{\cdot}1} = \frac{D^2 l}{A} \quad (5)$$

and

$$x = \frac{D'^2 l}{A \times 0{\cdot}1} = \frac{10 D'^2 l}{A} \quad (6)$$

Putting these equations into words:—

Rule 1.—When only the light under observation is reduced by turning the polariser, the "light proportion scale" is used, and the distance of this light from the screen is given in inches, then the square of this distance multiplied by the standard comparison light in candles, and this product divided by the reading on the "light proportion scale" (read as a whole number) gives the value in standard candles of the light observed.

Rule 2.—When only the light under observation is reduced by turning the polariser, the "light proportion scale" is used, and the distance of this light from the screen is given in feet, then the square of this distance multiplied by 10 and by the standard comparison light in candles, and the products divided by the reading on the "light proportion scale" (read as a whole number) gives the value in standard candles of the light observed.

In the discussion which followed the reading of the paper,

Mr. CROOKES pointed out that a candle is the most imperfect standard which can be used. No two standard candles agree. The variations are quite 10 per cent. between one set of standard candles and another.

Mr. A. P. TROTTER said there was rather a difficulty in working any binocular instrument, because one knows in the stereoscope, for example, how deceived one is as to what either eye is looking at, and when a very slight difference occurs in one eye or the other, one is very strongly tempted first to blink one eye and then the other to see whether there was the same appearance. There is always also a difficulty in the eye-piece instruments.

Prof. W. E. AYRTON had found that a candle pushed up by a spring through a nozzle, as used in the photometer, to be very uncertain as to its illuminating power. To use a candle with any certainty the whole of the upper part ought to be free from any surrounding screen, and certainly the wax must be free in the neighbourhood of the flame from any piece of metal. An important thing to remember in any photometer is that it is very desirable to be able to rapidly alter the luminosity of either the standard or the light you are trying to measure.

Sir DAVID SALOMONS having replied, a paper was read by Mr. WALKER, on "EARTH CURRENTS IN INDIA." (See last week's issue.)

In the discussion which followed the reading of the paper,

Mr. ADAMS had found that earth currents take a tidal form, that is, there are diurnal tides, neap and spring tides, semi-annual tides, and annual tides, the only difficulty being that they are mixed up. With regard to the coincidence between the variation of the atmospheric weight and the earth current variation, there is in that further evidence that the earth current variation and the magnetic variation are the results of variation in gravitation.

Mr. WALKER, in replying, said that a few years ago, after sending his earth current curve to the Colaba Observatory at Bombay for comparison with the magnetic curve of the day, Mr. Chambers, who was in charge of the observatory noticed a distinct similarity in the rise and fall of the earth current compared with the temperature of the surface soil in Bombay, so that there must be a very close coincidence between the effect of temperature on the earth's surface and the rise of the earth current.

The PRESIDENT, in proposing a vote of thanks to Mr. Walker, did not think that Mr. Walker had indicated in any way that any direct deviation has been shown between the currents due to atmospheric causes and currents due to changes in the potential of the earth. Some 30 or 40 years ago there was an extremely able paper on this subject, giving the results of some observations made in America. It was shown in this particular paper unmistakably that it was necessary to draw a great distinction between earth currents and atmospheric currents, and by very ingenious contrivances it was shown that the currents due to atmospheric electricity were just as frequent as those due to changes in the potential of the earth. Mr. Walker had suggested that the specific inductive capacity of the earth may change. It had always been the custom to regard the specific inductive capacity of the earth to have the value of 1. But it was not known what the value really is or what it ought to be. Long experience of telegraphy had led him to believe that this was not true, that the specific capacity of air is not 1, and that the specific capacity of air is variable. There is this striking fact, that the capacity of aerial lines in England is invariably greater than that in other countries. That may be due to the fact that the atmosphere in England is more charged with humidity than it is certainly in America. A valuable feature in Mr. Walker's paper is that he has given the value of the currents in volts. In order to make comparisons it is necessary to know the voltage, the direction of the lines observed, and their resistance.

Mr. FALKENSTEIN then read a paper on "Notes on the Influence of Electricity in Tanning Operations."

NEW PATENTS—1893.

6,439. "Improvements in electric switches." T. E. MARSH and T. G. POOLE. Dated March 27th.

6,446. "An apparatus for showing the phenomena of the expansion of crystals and other substances by heat produced by electric force." J. SWIFT. Dated March 27th.

6,468. "Improvements in electric arc lamps." SIEMENS BROS. AND CO., LTD., and J. NEBEL. Dated March 27th. (*Complete.*)

6,470. "Improvements in electrical measuring instruments." B. J. B. MILLS. (Communicated by A. E. Kennelly, United States.) Dated March 27th.

6,475. "Improvements in means and apparatus for varying the speed of electro-motors or the electromotive force of electro-dynamos." J. J. RICKARDS. Dated March 27th.

6,477. "Improvements relating to electro-plating and apparatus therefor." S. O. COWPER-COLES. Dated March 27th.

6,478. "Improvements in and relating to dynamo-electric machines and motors, and to circuits for use in connection therewith." E. THOMSON. Dated March 27th. (*Complete.*)

6,489. "Electric alarm in signal boxes, whereby railway collisions may be avoided, with or without the aid of additional signals." G. C. PURVIS. Dated March 28th.

6,517. "Induction system of electric heating and for other uses." S. B. JENKINS. Dated March 28th. (*Complete.*)

6,528. "Improvements in or relating to armatures." J. G. STATTER. Dated March 28th.

6,532. "Apparatus for recording excess currents in the working of electromotors for traction and other purposes." G. KAPP. Dated March 28th.

6,551. "A pyro-electric generator, an apparatus whereof such generator is an element, a process carried out by the aid of such apparatus, and a new compound gas made by such process." T. G. HALL. Dated March 28th. (*Complete.*)

6,556. "Improvements in electrical instruments for medical purposes." H. H. LAKE. (Communicated by Boyd's Medico-Electrical Vitalizer Co., United States.) Dated March 28th. (*Complete.*)

6,559. "Improvements in electric heating apparatus." M. W. DEWEY. Dated March 28th. (*Complete.*)

6,565. "An improvement in dry voltaic cells and in conducting connections for the carbons of these and other electric cells." SIEMENS BROS. & Co., LTD., and E. F. A. OBACH. Dated March 28th. (*Complete.*)

6,573. "Improvements relating to voltmeters." F. BROWN. Dated March 28th. (*Complete.*)

6,579. "Improvement in electrically heated radiator." W. MITCHELL. Dated March 28th. (*Complete.*)

6,605. "Improvements in diaphragms for use in electrolytic processes." E. T. PARKER. Dated March 29th.

6,613. "Improvements in street and like boxes for containing transformers used in electrical distribution." The Hon. C. A. PARSONS and J. B. WILLIS. Dated March 29th.

6,627. "Improvements in the working of railway signals and points by electricity." I. A. TIMMIS. Dated March 29th.

6,637. "Improvements in the application of electricity to closed carriages." F. W. GOLBY. (Communicated by A. Casella, jun., France.) Dated March 29th.

6,649. "Improvements in telephone transmitters." G. A. NUSSBAUM. Dated March 29th.

6,654. "An improvement in connection with electric bells and their contacts or current interruptors." E. F. TERREY. Dated March 29th.

6,666. "Improvements in or relating to the distribution of electricity." W. GEIPEL. Dated March 29th.

6,671. "Improvements relating to the electro-metallurgy of zinc." S. O. COWPER-COLES. Dated March 29th.

6,677. "Improvements in railway electrical signalling devices." W. GRIMES. Dated March 30th.

6,684. "Improvements in lighting and extinguishing attachments for electric and gas lamps." H. L. MULLER and W. ADKINS. Dated March 30th.

6,697. "Improvements in the heating of gases by electricity." W. DONALDSON. Dated March 30th.

6,702. "Improvements in dynamo brushes." K. KOCH. Dated March 30th. (*Complete.*)

6,723. "Improvements in coatings or coverings for electric conductors." C. T. SNEDEKOR. Dated March 30th.

6,742. "Improvements in electric arc lamps." J. D. F. ANDREWS. Dated March 30th.

6,751. "Improvements in the extraction of chromium by electrolysis." E. PLACET and J. BONNET. Dated March 30th.

6,780. "Improvements in secondary batteries." V. C. DOUBLEDAY. (Communicated by M. Sussmann, Germany.) Dated March 30th.

6,785. "Improvements in or connected with apparatus for feeding carbons in electric arc lamps." F. HALLOWS. Dated March 30th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

7,781. "A method of converting or transforming periodic electric currents to obtain constant effective intensity or voltage." P. BOUCHEROT. Dated May 5th. Claims:—1. The method of obtaining a current of constant effective intensity from a periodic electric current of constant effective electromotive force consisting in combining in series in the circuit of constant electromotive force, an apparatus possessing electrical capacity and one possessing the quality of self-induction, and connecting the circuit in which the constant effective intensity is required in shunt with either of these two apparatus. 2. The method of obtaining a constant effective difference of potential where a current of constant effective intensity is given, consisting in combining in shunt in the circuit in which the current of constant effective intensity is given an apparatus possessing electrical capacity and one having the quality of self-induction, whereby the constant difference of potential will be found between the one or other pair of adjacent terminals of these two apparatus.

11,113. "Improvements relating to electro-motors and to the transformation and distribution of electric currents." F. W. LAHMEYER. Dated June 30th. Relates to the use of high tension electro-motors, in which the field magnets are excited by a low-tension current, produced in a second winding of the armature. 2 claims.

12,525. "Electrical steering gear." G. S. GRIMSTON and A. H. DYKES. Dated July 23rd. Claim: Electrical steering gear, consisting of an electro-motor having its armature continually revolving in one direction, bevil gear with two magnetic clutches, whereby the armature is made to drive in either direction (according as the one clutch or the other is excited); a barrel connected by ropes or chains to a segment on the rudder head; a switch whereby the circuit for either magnetic clutch can be closed, and whereby the circuit is opened when the rudder has completed the desired movement, substantially as described.

12,602. "Improvements in apparatus for measuring electric currents." H. ARON. Dated July 24th. The inventor connects the shunt circuit of a motor-counting apparatus to suitable mechanism, such as a clock-work or wheel-work, which closes the shunt circuit during suitable intervals, for instance, during intervals of one or two minutes, for a very short period, say, a quarter or a-half second, after which the current is again interrupted. At each intermittent closing of the circuit the motor receives strong impulses, which impart motion to the same, while, in the intervals, owing to the consumption of energy through mechanical or magnetical friction, or any other passive resistance, the motion of the motor is being slowed down, and either stopped or retarded till the next impulse gives it a fresh start. 1 claim.

12,831. "Improvements in curative electric belts and other articles of wearing apparel." W. RUSSELL. Dated July 28th. The belt consists of as many sectional bands as may be necessary for the required length. The sectional bands are of solid silver or inferior metal, electro silver-plated; they are thin and pliable. The edges are perforated and stitched with cotton twist to form a border. Each section is surmounted with three or more small round metal plates, perforated with three holes. These plates or discs are of an electrical opposite nature to the bands such as zinc or aluminium. An absorption pad lies under each disc or round plate, which is secured to the sectional band with one rivet through its centre. 1 claim.

13,124. "Improvements in heating and welding by electricity." H. HOWARD. Dated August 1st. The positive pole of the battery or other source of electricity is connected to a block of carbon, which may rest upon or be partially surrounded by firebrick or similar material, to increase the radiation of the heat on one side of the work, and is led from thence by a conductor to the work, or to the support on which the work rests, whilst the negative pole is connected to a pencil of carbon situated on the other side of the work, an electric arc being formed between the pencil and the work, so that the work is heated on one side by the arc, and on the other by radiation from the heated block. 4 claims.

13,250. "Improvements in electrical switches and safety fuses." W. H. WHEATLEY. (A communication from abroad by A. Ashfalck, of Cologne.) Dated August 5th. A switch constructed according to this invention comprises an insulating base with a stud on which is mounted an insulating disc connected to an operating lever, and carrying at each side two contact pieces arranged opposite to one another. The disc is arranged to rotate between two pairs of spring contacts connected to the house conductors and to two metallic catches. The cover of the switches has secured inside two metallic terminals connected to the conductors passing through a central hole and leading to the lamp, and also two metallic pieces provided with tongues adapted to engage with metallic catches on the base. The metallic terminals and pieces are provided with clips to retain lead or other safety fuses inserted between, and which connect each terminal with the corresponding piece, and thus, when the cover is in position, with the spring contacts.

13,961. "Appliances for an electrical parcel exchange system." A. R. BENNETT. Dated August 19th. The object of the invention is to develop and render more complete the invention entitled, "An Electrical Parcel Exchange System," described in specification No. 12,934, of July 30th, 1891. 2 claims.

14,217. "Improvements in telegraphic apparatus." G. SACCO and L. GIACOMINI. Dated August 22nd. Relates to a special form of relay, consisting of two small natural magnets balanced so that their like poles lie over the two poles of an electro-magnet, which normally attracts them both. On a positive current passing through the relay, one of the said natural magnets will become detached from the core of the electro-magnet, and the other natural magnet will be attracted by a still greater force, and will not therefore move. On a negative current being passed through the relay, the other natural magnet is similarly actuated. This movement of the magnet is made to make the local circuit of one or other of the two electro-magnets of the printing apparatus. The return of the armatures of either of these electro-magnets causes an extension thereof to strike the first of four catches, each of which retains one of four racks from sliding longitudinally under the action of a spring. When so struck the catch releases the rack, which therefore slides forward. Both armatures effect the same purpose, but the movement of the extension of one of them being limited by a stop, it effects but half of the full movement of the sliding racks, therefore representing, as it were, dots, while the said full movement represents dashes. The movement of either armature also acts through a pawl to partially rotate a ratchet wheel which in its rotation brings each sliding rack in turn under the operation of the armatures. By the means described the four racks may be arranged in twenty-six differently combined positions, each one of which will allow a certain different one of twenty-six levers or keys arranged thereover to fall into a series of recesses presented to it by the said peculiar combination of racks. When so depressed each lever acts as a stop to a cylinder carrying twenty-six projecting pins so arranged that on one of them coming in contact with its corresponding depressed lever, a type-wheel rotating with the cylinder is in such a position that a certain type, agreeing with the particular lever depressed, upon its periphery is brought into the proper position for printing. The depression of any of the levers also operates to remove a brake from the type-wheel and hereinbefore-mentioned cylinder so as to connect them by frictional contact with a continuously rotating shaft actuated by clockwork whereby they are rotated. The impression wheel behind the paper to receive the message is also caused to strike against the type-wheel, the moment that the proper type is presented in printing position, by the action of any of the said keys. After this all parts resume their normal position by means of eccentrics. Both a feeble and a strong current are employed to actuate the apparatus.

16,090. "Improvements in telegraph posts." W. PITT. Dated September 22nd. The inventor constructs telegraph and other poles, or the lower part of them, of three pieces of angle iron arranged in the form of a pyramid. These angle irons are held in place by castings, which consist of three rings of suitable form for each to encircle one of the angle irons, and connected by arms to a central eye. The ends of the arms next the rings have recesses in them to receive wedges. The upper and lower castings are of similar construction to the intermediate ones, except that in place of rings there are recesses not going completely through them to receive the ends of the angle irons. The lower casting is provided with legs to enter the ground. The castings diminish in size from the ground upwards 2 claims.

17,231. "Improved winding for drum armatures of dynamos and electromotors." SIEMENS BROS. and CO. LTD., J. NEBEL, and F. H. VALTER. (Dated October 9th.) Consists in winding the several convolutions one above the other in planes radiating from the axis of the armature, instead of side by side circumferentially as has hitherto been the usual practice. 1 claim.

CORRESPONDENCE.

Railway Train Lighting.

In your issue of the 7th inst. there appears a letter bearing the signature of "J.," dated Newcastle-on-Tyne, March 27th, which, although written under the above heading, is evidently levelled against the credit which has been accorded the Midland Railway Company for the general advances which it is recognised that company has of recent years made in its application of the electric light to railway purposes.

Presumably, it is to your article of March 17th, entitled, "The Midland Railway and Electric Lighting," to which the writer refers; for, although I observe there are articles in your impression of the same date for February, on "Railway Train Lighting" (America), it would seem clear from the context of "J.'s" remarks that it is the article of March 17th which has raised his ire, and not, as his letter otherwise suggests, February 17th.

It is not my practice to take notice of such communications, nor should I in this instance were it not that you, having been good enough to notice on one or more occasions the progress of electric lighting on the Midland Railway, I feel that it would be scarcely honourable of me, either to yourselves or to your readers, to allow this letter to go unanswered.

Your article of the 17th March, as I read it, is a simple

enough statement of an installation recently brought into operation, established purely in the interest, and for the welfare of the Midland Company's clerical staff stationed at Derby, the headquarters of the company. And it is, as I gather, mainly with the object of directing attention to the foresight and consideration of the company in thus regarding the welfare of their *employés* that the subject has received at your hands the prominence you have accorded it. I readily avail myself of this opportunity to tender to you my thanks for the recognition which you have afforded the subject—not merely in that you have been pleased to speak favourably of the manner in which the work has been carried out, but more especially with regard to your concluding remarks. There can be no question that a great boon has been conferred upon a most meritorious class of hard workers, whose duties unavoidably entail upon them a large amount of labour under the influence of artificial light; and I quite concur with you in your expression that the introduction of the electric light into those offices in which this work has to be done, will add to the length of life of those who use such offices.

That you should, under these circumstances, express a wish that other railway companies would do likewise, I doubt not, will have earned the hearty thanks of all, except "J.," who may have read your amiable and humane expression.

It is clear, however, that "J.'s" object is not so much the consideration of your article, as it is to have a shot at the Midland. Why, it is difficult to see. Apparently he conceives that too much prominence has been accorded to the Midland Company's efforts in advancing electric lighting. I do not at all desire to disparage the works of others, nor have I ever claimed for the Midland the honour of pioneering the electric light. In a paper read by me before the Institution of Civil Engineers, I emphatically accorded to Mr. Houghton, of the Brighton Company, the first place in the application of the electric light to railway travelling. At the same time it cannot be denied that the Midland has entered into that question in a far more exhaustive manner than any other company. Nor has the Midland ever laid claim to being the first to employ the light for its stations, goods yards, warehouses, &c. Nor has it "gingerly" followed the footsteps of others. In its arc lighting it has adopted a system which was at the time employed by no other railway company, and although the system is now largely used, was then very little in use. In its train lighting it, as stated in the paper previously referred to, adopted Mr. Houghton's method for trains *en bloc*; but a perfectly novel course was pursued with regard to all other trains.

The general lighting work which the Midland has in hand, and has already carried out, will, I venture to think, fully justify, however, any views you may have expressed with respect to the use which the Midland is making of electric lighting. It is in no boastful spirit, but entirely for the purpose of showing—if, indeed, such be necessary—how unjustifiable are the uncalled for remarks of your correspondent that I here enumerate broadly of what that work consists at the present moment.

Works in Operation.

	Incandescent lights.	Arc lights. 1,200 to 2,000 C.P.
St. Pancras Hotel	1,000	2
Derby offices	2,000	...
" Telegraph Stores and Shops ...	130	...
Leeds, Hunslet Goods	220	145
Bradford Hotel and Station	670	70
Birmingham, Central Goods Station ...	90	66
" Lawley Street	...	132
St. Pancras Passenger Station, Somer's Town Goods, St. Pancras Goods ...	36	213
Approximate total in operation	4,146	628

Works in progress and already provided for.

Birmingham, Lawley Street	300	100
" Central Goods Depôt Offices	100	...
Leicester New Passenger Station and Goods, Warehouse, &c.	...	135
St. Pancras, Sidings	...	12
Shefficld	200	140
Liverpool	150	130
Approximate total in progress	750	517

These figures, showing a total of over 4,000 incandescent and over 600 arc lights in use, and of 900 incandescent and 517 arc lights now under construction, producing a total in all of some 5,000 incandescent, and 1,100 arc lights, will enable your readers to determine whether, in any remarks you may have made with respect to electrical work on the Midland, you have given it such undue prominence as "J." suggests. Your columns have at all times, as perhaps I may add in duty bound, chronicled with that impartiality which characterises your pages, most, if not all, important advances in the application of that force which people look upon as destined to play an important part in the near future; and, if I mistake not, you have devoted, in time gone by, many columns to the Great Western installation at Paddington. In the figures quoted, I have purposely refrained from reference to train lighting, for the reason that I do not regard it as an established installation. Were I to do so, it would largely increase the number.

I emphatically deny that the Midland has ever displayed, in word or deed, the slightest anxiety to assume priority in the matter of electric lighting, or anything else. The telegraph department of the Midland Railway has pursued its own course, content to do the work entrusted to it to the best of its ability. It has not "gingerly" followed the footsteps of others, but done that which appeared most suitable to its requirements. Although we have no "intricate connections" to show "J.," I will readily promise him that if he will come out of his shell, and send me his card, he shall have every opportunity of criticising the work referred to in your article, and which has elicited from him such uncalled for remarks.

W. Langdon.

Telegraph Department,
Midland Railway, Derby,
April 10th, 1893.

Comparative Tests of Hellesen and E.C.C. Dry Batteries.

The report which you have published of the results of the comparative tests of Hellesen and E.C.C. dry cells is a very interesting one, and appears to show a decided balance of superiority in favour of the latter. I suspect, however, that a good deal of this is more apparent than real. The cells compared were of unequal size in all the tests, and the Hellesen cell was generally the smaller of the two. If the E.C.C. cell were really the best, the results of testing would have been made more convincing by pitting it against a Hellesen cell of greater weight than its own.

The difference in weight between two of the cells compared (No. 3 Hellesen and No. 2 E.C.C.) is a quarter of pound, and when a further allowance is made for the dead weight of the pasteboard casing and the sawdust packing of the Hellesen, and for the extra thickness of zinc in that cell, it will be seen that the difference is considerably in favour of the E.C.C. cell, and it is only natural that the bigger cell should have a lower internal resistance and should run for a longer time than the smaller one.

The comparison of new dry cells with one another is only a part of what is required to be done before their relative merits can be weighed. Another very important question to be settled is the question of how the cells will bear being kept for a period of several months, so that it is a good plan to put dry cells upon the shelf for six months before testing them. At any rate this is true of cells used for medical purposes; for these it is a *sine quâ non* that they must keep well, and not deteriorate on open circuit.

I have compared the present values of some small size cells of both the makers, and after a lapse of twelve months find that the E.C.C. cell (No. 4, weight ·65 lb.) is in a very bad state, with zinc cases bulged and corroded through, and with an internal resistance of 100 ohms, while the Hellesen (No. 6, weight ·51 lb.) is still in good order, and its internal resistance is only 4 ohms. The E.M.F. of both cells is about 1·25 volt, the Hellesen being a trifle the better of the two. No work has been taken out of either of the cells except in very small amounts, and at rare intervals, for testing, during the past twelve months.

H. Lewis Jones.